

(19)



Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 0 845 451 A1

(12)

EUROPEAN PATENT APPLICATION

published in accordance with Art. 158(3) EPC

(43) Date of publication:
03.06.1998 Bulletin 1998/23

(21) Application number: 96921146.5

(22) Date of filing: 02.07.1996

(51) Int. Cl.⁶: **C07C 43/178**, C07C 43/196,
C07C 43/23, C07C 217/30,
C07C 217/48, C07C 317/18,
C07C 317/20, C07C 317/22,
C07C 323/16, C07C 323/17,
C07C 323/18

(86) International application number:
PCT/JP96/01833

(87) International publication number:
WO 97/05091 (13.02.1997 Gazette 1997/08)

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GB GR IE IT LI LU NL
PT SE

(30) Priority: 26.07.1995 JP 209279/95

(71) Applicant:
ONO PHARMACEUTICAL CO., LTD.
Osaka-shi Osaka 541 (JP)

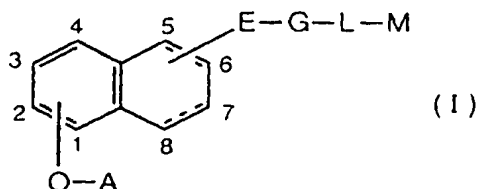
(72) Inventors:
• NAGAO, Yuuki
Shimamoto-cho, Mishima-gun, Osaka 618 (JP)

• TORISU, Kazuhiko
Shimamoto-cho, Mishima-gun, Osaka 618 (JP)
• HAMANAKA, Nobuyuki
Shimamoto-cho, Mishima-gun, Osaka 618 (JP)

(74) Representative: Bentham, Stephen
J.A. KEMP & CO.
14 South Square
Gray's Inn
London WC1R 5LX (GB)

(54) NAPHTHYLOXYACETIC ACID DERIVATIVES AND DRUGS COMPRISING THE SAME AS ACTIVE INGREDIENTS

(57) The naphthyloxyacetic acid derivatives of the formula (I)



The compounds of the formula (I) can combine PGE₂ receptor and exhibit the activity to antagonize or agonize for PGE₂ receptor. Therefore, they are useful for anti-hyperlipemia, for the prevention of abortion, as analgesics, as antidiarrheals, as sleep inducers, or as diuretic, anti-diabetes, abortifacient, cathartic, antiulcer, anti-gastritis or antihypertensive agents etc.

wherein A is H, -(alkylene)COOR¹, -(alkylene)CONR²R³, -(alkylene)OH, -(alkylene)tetrazole, -(alkylene)CN; E is single bond or alkylene; G is S-, -SO-, -SO₂-, -O- or -NR⁴-; L is alkylene, -(CH₂)_m-CH=CH-(CH₂)_n- or -(CH₂)_x-CH(OH)-(CH₂)_y-; M is phenyl, phenyl(thio, oxy, amino), diphenylmethyl, diphenylmethyl(thio, oxy, amino), and pharmaceutical composition comprising them as an active ingredient.

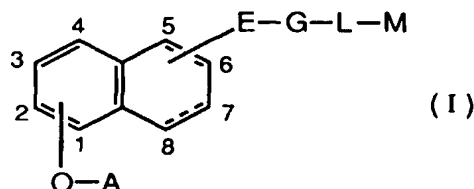
EP 0 845 451 A1

Description

Field of technology

This invention relates to the naphthylxyacetic acid derivatives. More particularly, this invention relates to

(1) the naphthylxyacetic acid derivatives of the formula (I)



wherein all symbols are as hereinafter defined, or non-toxic salts thereof, acid addition salts thereof or hydrates thereof and

(2) a pharmaceutical composition (Prostaglandin E_2 (PGE_2) antagonists or agonists) which comprises them as an active ingredient.

Background

PGE_2 has been known as metabolite in the arachidonate cascade. In addition, the recent progress in the molecular biological technology makes the existence of three PGE_2 receptors clear as shown in the following and has been making the relationship between each receptor and appearance of biological activity clear. For example, EP_1 receptor may cause contraction of the smooth muscle of digestive canal or bronchus etc. and promote the release of neurotransmitter. The representative activity of EP_2 receptor is relaxation of smooth muscle of bronchus or ileum etc. or vasodilatation and reduction of the blood pressure due to relaxation of vascular smooth muscle. As the activity of EP_3 receptor, uterine muscle contraction, suppression of gastric acid secretion, inhibition of reabsorption of water and ion by vasopressin in renes, inhibition of fat decomposition in fat tissue, inhibition of release of neurotransmitter and glucose-decomposition by gulcagon in liver cell etc. have been known. In addition, recently, the existence of fourth receptor is suggested. (Biochemistry Vol. 66, No. 3, pp. 218-231 (1994))

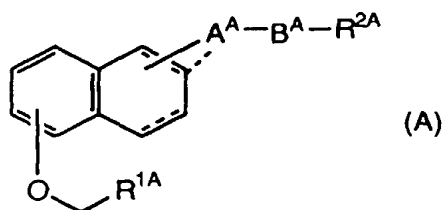
Therefore, to antagonize PGE_2 receptor means to suppress the effects above mentioned, so such an activity is linked to inhibition diuresis, to inhibition of hyperlipemia, to inhibition of reduction of blood sugar, to inhibition of uterine contraction, to analgesic action, to inhibition of digestive peristalsis, to induction of sleep. Therefore, PGE_2 receptor antagonists are considered to be useful for anti-hyperlipemia, for the prevention of abortion, as analgesics, or as anti-diarrheals or sleep inducers.

To agonize for PGE_2 receptor means to promote the effects above mentioned, so such an activity is linked to diuresis, to promotion of hyperlipemia, to promotion of reduction of blood sugar, to uterine contraction, to promotion of digestive peristalsis, to suppression of gastric acid secretion or to reduction of blood pressure. Therefore, PGE_2 receptor agonists are considered to be useful as diuretic, anti-diabetes, abortifacient, cathartic, antiulcer, anti-gastritis or anti-hypertensive agents.

In such a background, a lot of compounds which agonize or antagonize for PGE_2 receptors have been proposed. For example, in the specification of EP-0657422, it is disclosed that the compounds of the formula (A)

5

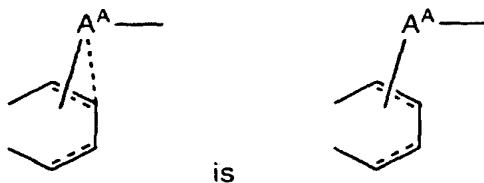
10



15

wherein R^{1A} is $-\text{COOR}^{4A}$ in which R^{4A} is hydrogen or C1-4 alkyl, $-\text{CONR}^{5A}\text{R}^{6A}$ in which R^{5A} and R^{6A} each, independently, is hydrogen, C1-4 alkyl or C1-4 alkyl substituted by 1 of hydroxy or $-\text{CH}_2\text{OH}$,

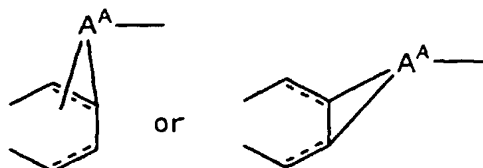
20



25

in which A^A is single bond or C1-4 alkylene or

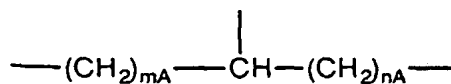
30



35

40 in which A^A is

45



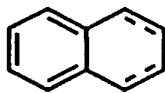
50

in which m_A is 0, 1, 2, 3, 4, n_A is 0, 1, 2, 3, 4, and $m_A + n_A$ is 2, 3, 4, B^A is $-\text{NR}^{3A}\text{SO}_2-$ or $-\text{SO}_2\text{NR}^{3A}-$ in which R^{3A} is hydrogen, C1-4 alkyl or $-\text{CH}_2\text{COOR}^{7A}$ in which R^{7A} is hydrogen or R^{4aA} , in which R^{4aA} is C1-4 alkyl, R^{2A} is (i) C1-6 alkyl, C2-6 alkenyl or C2-6 alkynyl,

(ii) C1-6 alkyl, C2-6 alkenyl or C2-6 alkynyl substituted by 1, 2 or 3 of phenyl, C4-7 cycloalkyl or phenyl substituted by 1, 2 or 3 substituents selected from C1-4 alkyl, C1-4 alkoxy or halogen or

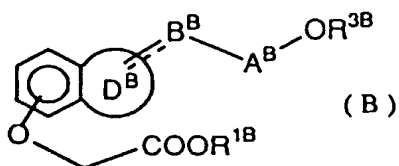
55

(iii) naphthyl,
in the formula

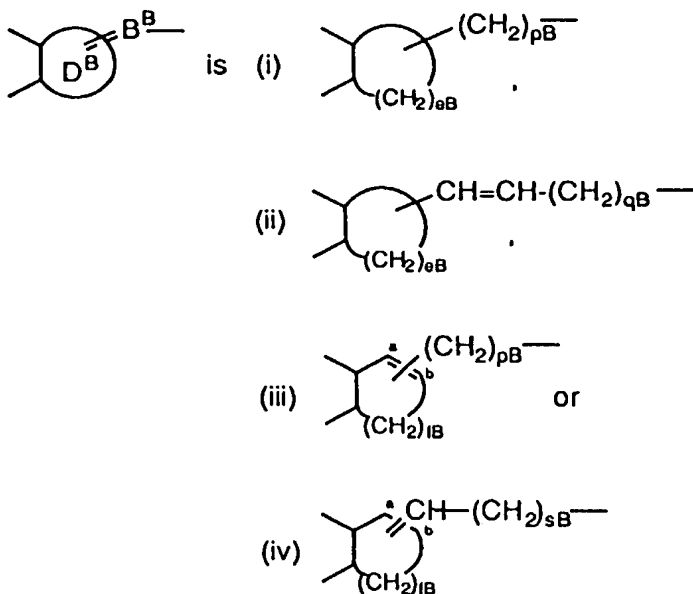


----- is single bond or double bond,
or non-toxic salts thereof, are useful as PGE₂ antagonist or agonist.

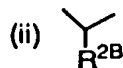
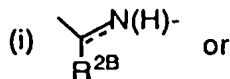
As for different activity case, in the specification of EP-0578847 (corresponding to JP Patent Application Kokai Hei 6-25074), it is disclosed that the compounds of the formula (B)



wherein,



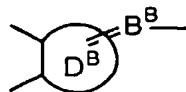
A^B is



R^{1B} is hydrogen or C1-4 alkyl,
 R^{2B} is hydrogen, C1-6 alkyl or phenyl,
 R^{3B} is

- (i) C1-15 alkyl,
- (ii) C1-8 alkyl substituted by 1 or 2 of benzene ring, C4-7 cycloalkyl or 4-7 membered monocyclic ring containing one nitrogen,
- (iii) C10-15 fused tricyclic ring,

e^B is an integer of 3-5,
 f^B is an integer of 1-3,
 p^B is 0 or an integer of 1-4,
 q^B is 0, 1 or 2,
 s^B is 0 or an integer of 1-3 ;
 with the proviso that, when



is (iii) or (iv), $-(CH_2)_p^B$ - and $=CH-(CH_2)_s^B$ - is bonded at the position a or b on the ring, and the ring in R^{3B} may be substituted by one to three of C1-4 alkyl, C1-4 alkoxy, halogen, nitro or trihalomethyl, are useful as PGI_2 agonist.

In the specification of JP Patent Application Kokai Sho 61-267532, it is disclosed that the compounds of the formula

(D)



wherein Ar^{1D} is a nitrogen, sulfur or oxygen containing heterocyclic ring or an aromatic ring,

Ar^D is a phenyl or nitrogen, oxygen or sulfur containing heterocyclic ring,

Ar^{1D} and Ar may be fully substituted or less than fully substituted by H, CH_3 , lower alkyl, aryl, aralkyl, halogen, hydroxy, lower alkoxy, CF_3 , $COOH$, alkylcarboxy, arylcarboxy, alkylcarbalkoxy, alkanoyl, formyl, oxo, nitrilo, amino, aminoalkyl, alkylamine, carboxamide, aryloxy, nitro, sulfonyl, sulfonamide, thio, alkylthio, hydroxyalkyl or oxyalkyl-carboxy,

X^D is $-O(CHR^{1D})_{n^D}$ -, $-S(O)_{n^D}$ -, $-(CHR^{1D})_{n^D}$ -, $-NR^{1D}(CHR^{1D})_{n^D}$ -alkylene of up to 2 carbon atoms in the principal chain and up to a total 4 carbon atoms,

$-C(R^{1D})=(CR^{1D})$ -, $-C \equiv C$ -, $-CO(CHR^{1D})_{n^D}$ -, $-CH(OH)-(CHR^{1D})_{n^D}$ -, $-CH=N$ -, $-CO-O$ -, $-CO-S$ -, or $-CO-N(R^{1D})$ -,

Z^D is an alkylene containing up to 10 carbon atoms in principal chain and a total of up to 12 carbon atoms and from 0 to 2 double bonds and the said alkylene chain may be attached to Ar^D through an oxygen, sulfur or amino nitrogen atom,

and when n^D is 2 or more, one of the R^D substituents may be halogen on an omega carbon of the alkylene chain Z^D ,

when n^D is 1, R^D is a substituent attached to one of the carbon atoms of Z^D selected from the group consisting of

oxo, OR^{3D} , SR^{3D} , $N(R^{2D})_2$, R^{1D} and $-CO R^{4D}$,
 when $n^{D'}$ is 2 or more, one R^D is as previously defined, and the other R^D is a substituent attached to one of the
 carbon atoms of Z^D selected from the group consisting of oxo, OR^{3D} , SR^{3D} , $N(R^{2D})_2$, $-COR^{4D}$, lactone and halogen,
 R^{1D} is H or CH_3 ,
 R^{2D} is H, lower alkyl, aryl or aralkyl,
 R^{3D} is H, lower alkyl, lower alkanoyl, aryl, aralkyl or substituted aryl in which the substituent is halogen, lower alkyl
 or lower alkoxy,
 R^{4D} is O R^{2D} or $N(R^{2D})_2$,
 n^D is 0 or 1,
 $n^{D'}$ is an integer of 1-7,
 $n^{D''}$ is 0, 1 or 2,
 possess the anti-inflammatory and anti-allergic activity due to lipoxigenase inhibition.

In addition, in the specification of (E) USP-4327022, (F) JP Patent Application Kokai Sho 50-89352 and (G) USP-
 3930672, it is disclosed that the naphthol derivatives are useful as (1) cardiotonic or anti-bacterial agents, (2) analgesic,
 anti-inflammatory and antipyretic agent and (3) starting material of the compound related to copy paper, respectively.

Disclosure of the Invention

Purpose of the Invention

The present inventors have been studying in order to find out PGE_2 antagonists or agonists which have new skeleton in structure, and then have found out that the naphthyloxy acetic acid derivatives (compounds of the formula (I) as mentioned hereinafter) in which thioether, sulfinyl, sulfonyl, ether or amine are introduced into the side chain are useful as PGE_2 antagonist or agonist, particularly, the mentioned compounds can bind the EP_3 receptor strongly. And then, the present invention has been completed.

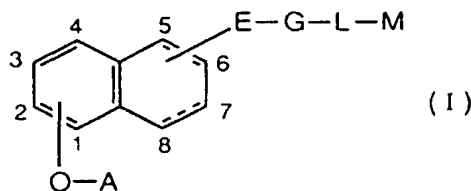
Comparison with Related Art

The compounds of the formula (A) as mentioned in Related Art possess $-NR^{3A}SO_2-$ or $-SO_2NR^{3A}$ wherein all symbols are as defined hereinbefore, in the side chain as basic structure. On the other hand, corresponding part in the present invention compounds is thioether, sulfinyl, sulfonyl, ether or amine.

The compounds of the formula (B), (D) and the compounds described in (E), (F) and (G) as mentioned in Related Art possess (1) PGI_2 agnostic activity, (2) anti-inflammatory and anti-allergic activity due to lipoxigenase inhibition (3) cardiotonic or anti-bacterial agents, (4) analgesic, anti-inflammatory and antipyretic agent and (5) starting material of the compound related to copy paper, respectively. On the other hand, the present invention compounds possess the PGE_2 antagonistic or agonistic activity.

That is to say, the present invention provides:

1) a naphthyloxyacetic acid derivative of the formula (I)



wherein

A is

- (i) hydrogen,
- (ii) $-(C1-4 \text{ alkylene})-COOR^1$ in which R^1 is hydrogen or C1-4 alkyl,
- (iii) $-(C1-4 \text{ alkylene})-CONR^2R^3$ in which R^2 and R^3 each,

independently, is hydrogen or C1-4 alkyl,

(iv) -(C1-4 alkylene)-OH,

(v) -(C1-4 alkylene)-tetrazolyl or

(vi) -(C1-4 alkylene)-CN;

5

E is

(i) single bond or

(ii) C1-6 alkylene;

10

G is -S-, -SO-, -SO₂-, -O- or -NR⁴- in which, R⁴ is hydrogen or C1-4 alkyl;

L is

(i) C1-6 alkylene,

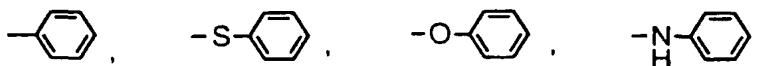
15

(ii) -(CH₂)_m-CH=CH-(CH₂)_n- in which m is 0 or an integer of 1-3, n is 0 or an integer of 1-3 or

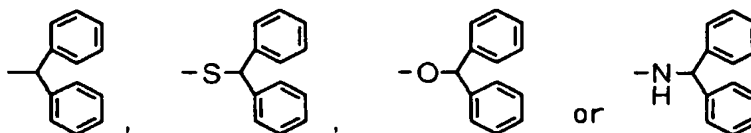
(iii) -(CH₂)_x-CH(OH)-(CH₂)_y- in which x is an integer of 1-3, y is 0 or an integer of 1-3;

M is

20



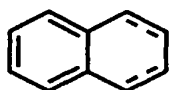
25



30

in which each phenyl group may be substituted by 1-3 of C1-4 alkyl, C1-4 alkoxy, halogen, nitro or trifluoromethyl;
in the formula

35



40

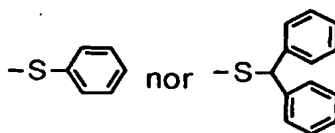
--- is single bond or double bond;

with the proviso that,

45

(1) when G is -SO- or -SO₂-, M is neither

50

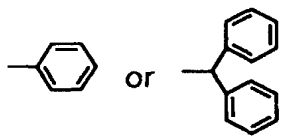


55

in which each phenyl group may be substituted by 1-3 of C1-4 alkyl, C1-4 alkoxy, halogen, nitro or trifluoromethyl,

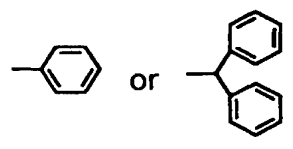
(2) when m in L is 0, G is -SO- or -SO₂-,

(3) when n in L is 0, M is



10 in which each phenyl group may be substituted by 1-3 of C1-4 alkyl, C1-4 alkoxy, halogen, nitro or trifluoromethyl,

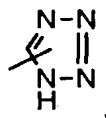
(4) when y in L is 0, M is



20 in which each phenyl group may be substituted by 1-3 of C1-4 alkyl, C1-4 alkoxy, halogen, nitro or trifluoromethyl,

(5) when A is hydrogen, L is $-(CH_2)_m-CH=CH-(CH_2)_n-$ in which m and n are as hereinbefore defined, or $-(CH_2)_x-CH(OH)-(CH_2)_y-$ in which x and y are as hereinbefore defined, and

(6) tetrazolyl in A is



35 or non-toxic salt thereof, non-toxic acid addition salt thereof or hydrate thereof,

2) a compound described in 1), wherein A is $-(C1-4 \text{ alkylene})-COOR^1$,

3) a compound described in 1), wherein A is $-(C1-4 \text{ alkylene})-CONR^2R^3$, $-(C1-4 \text{ alkylene})-OH$, $-(C1-4 \text{ alkylene})$ -tetrazolyl or $-(C1-4 \text{ alkylene})-CN$,

4) a compound described in 1), wherein A is hydrogen,

5) a compound described in 1)-5), wherein L is $-(CH_2)_m-CH=CH-(CH_2)_n-$ or $-(CH_2)_x-CH(OH)-(CH_2)_y-$,

6) a compound described in 5), wherein G is $-S-$, $-SO-$ or $-SO_2-$,

7) a compound described in 5), wherein G is $-O-$,

8) a compound described in 5), wherein G is $-NR^4-$,

9) a compound described in 6), which is

- 55
- (1) 1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-phenoxy-2RS-propanol,
 - (2) 1-[2-(5-hydroxy-1-naphthyl)ethylsulfinyl]-3-phenoxy-2RS-propanol,
 - (3) 1-[2-(5-hydroxy-1-naphthyl)ethylsulfonyl]-3-phenoxy-2RS-propanol,
 - (4) 1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-phenoxy-2R-propanol,
 - (5) 1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-phenoxy-2S-propanol,

- (6) 1-(5-hydroxy-1-naphthyl)methylthio-3-phenoxy-2RS-propanol,
- (7) 1-(5-hydroxy-1-naphthyl)methylsulfinyl-3-phenoxy-2RS-propanol,
- (8) 1-(5-hydroxy-1-naphthyl)methylsulfonyl-3-phenoxy-2RS-propanol,
- (9) 2-[3-(5-hydroxy-1-naphthyl)propylthio]-1-phenyl-1RS-ethanol,
- 5 (10) 2-[3-(5-hydroxy-1-naphthyl)propylsulfinyl]-1-phenyl-1RS-ethanol,
- (11) 2-[3-(5-hydroxy-1-naphthyl)propylsulfonyl]-1-phenyl-1RS-ethanol,
- (12) 1-(5-hydroxy-1-naphthyl)thio-3-phenoxy-2RS-propanol,
- (13) 1-(5-hydroxy-1-naphthyl)sulfinyl-3-phenoxy-2RS-propanol,
- (14) 1-(5-hydroxy-1-naphthyl)sulfonyl-3-phenoxy-2RS-propanol,
- 10 (15) 1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-(4-chlorophenoxy)-2RS-propanol,
- (16) 1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-(4-methylphenoxy)-2RS-propanol,
- (17) 1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-(4-methoxyphenoxy)-2RS-propanol,
- (18) 1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-diphenylmethoxy-2RS-propanol,
- (19) 1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-[1-phenyl-1-(4-chlorophenyl)methoxy]-2RS-propanol,
- 15 (20) 1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-phenylthio-2RS-propanol,
- (21) 1-(5-hydroxy-1-naphthyl)methylthio-3-diphenylmethoxy-2RS-propanol,
- (22) 1-(5-hydroxy-1-naphthyl)methylthio-3-[1-phenyl-1-(4-chlorophenyl)methoxy]-2RS-propanol,
- (23) 2-[5-[2-(2RS-hydroxy-3-phenoxypropylthio)ethyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (24) 2-[5-[2-(2RS-hydroxy-3-phenoxypropylsulfinyl)ethyl]-1-naphthyl]oxy}acetic acid methyl ester,
- 20 (25) 2-[5-[2-(2RS-hydroxy-3-phenoxypropylsulfonyl)ethyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (26) 2-[5-[2-(2RS-hydroxy-3-phenoxypropylthio)ethyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (27) 2-[5-[2-(2S-hydroxy-3-phenoxypropylthio)ethyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (28) 2-[5-[2-(2RS-hydroxy-3-phenoxypropylthio)methyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (29) 2-[5-[2-(2RS-hydroxy-3-phenoxypropylsulfinyl)methyl]-1-naphthyl]oxy}acetic acid methyl ester,
- 25 (30) 2-[5-[2-(2RS-hydroxy-3-phenoxypropylsulfonyl)methyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (31) 2-[5-[3-(2RS-hydroxy-2-phenylethylthio)propyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (32) 2-[5-[3-(2RS-hydroxy-2-phenylethylsulfinyl)propyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (33) 2-[5-[3-(2RS-hydroxy-2-phenylethylsulfonyl)propyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (34) 2-[5-[2RS-hydroxy-3-phenoxypropylthio]-1-naphthyl]oxy}acetic acid methyl ester,
- 30 (35) 2-[5-[2RS-hydroxy-3-phenoxypropylsulfinyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (36) 2-[5-[2RS-hydroxy-3-phenoxypropylsulfonyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (37) 2-[5-(3-styrylsulfonylpropyl)-1-naphthyl]oxy}acetic acid methyl ester,
- (38) 2-[5-(3-styrylsulfinylpropyl)-1-naphthyl]oxy}acetic acid methyl ester,
- (39) 2-[5-[2-(2RS-hydroxy-3-(4-chlorophenoxy)propylthio)ethyl]-1-naphthyl]oxy}acetic acid methyl ester,
- 35 (40) 2-[5-[2-(2RS-hydroxy-3-(4-methylphenoxy)propylthio)ethyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (41) 2-[5-[2-(2RS-hydroxy-3-(4-methoxyphenoxy)propylthio)ethyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (42) 2-[5-[2-(2RS-hydroxy-3-diphenylmethoxypropylthio)ethyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (43) 2-[5-[2-(2RS-hydroxy-3-(1-phenyl-1-(4-chlorophenyl)methoxy)propylthio)ethyl]-1-naphthyl]oxy}acetic acid methyl ester,
- 40 (44) 2-[5-[2-(2RS-hydroxy-3-phenylthiopropylthio)ethyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (45) 2-[5-(2RS-hydroxy-3-diphenylmethoxypropylthio)methyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (46) 2-[5-[2RS-hydroxy-3-(1-phenyl-1-(4-chlorophenyl)methoxy)propylthio)methyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (47) 2-[5-[2-(2RS-hydroxy-3-phenoxypropylthio)ethyl]-1-naphthyl]oxy}acetic acid,
- 45 (48) 2-[5-[2-(2RS-hydroxy-3-phenoxypropylsulfinyl)ethyl]-1-naphthyl]oxy}acetic acid,
- (49) 2-[5-[2-(2RS-hydroxy-3-phenoxypropylsulfonyl)ethyl]-1-naphthyl]oxy}acetic acid,
- (50) 2-[5-[2-(2R-hydroxy-3-phenoxypropylthio)ethyl]-1-naphthyl]oxy}acetic acid,
- (51) 2-[5-[2-(2S-hydroxy-3-phenoxypropylthio)ethyl]-1-naphthyl]oxy}acetic acid,
- (52) 2-[5-(2RS-hydroxy-3-phenoxypropylthio)methyl]-1-naphthyl]oxy}acetic acid,
- 50 (53) 2-[5-(2RS-hydroxy-3-phenoxypropylsulfinyl)methyl]-1-naphthyl]oxy}acetic acid,
- (54) 2-[5-(2RS-hydroxy-3-phenoxypropylsulfonyl)methyl]-1-naphthyl]oxy}acetic acid,
- (55) 2-[5-[3-(2RS-hydroxy-2-phenylethylthio)propyl]-1-naphthyl]oxy}acetic acid,
- (56) 2-[5-(2RS-hydroxy-3-phenoxypropylthio)-1-naphthyl]oxy}acetic acid,
- (57) 2-[5-(2RS-hydroxy-3-phenoxypropylsulfinyl)-1-naphthyl]oxy}acetic acid,
- 55 (58) 2-[5-(2RS-hydroxy-3-phenoxypropylsulfonyl)-1-naphthyl]oxy}acetic acid,
- (59) 2-[5-(3-styrylsulfinylpropyl)-1-naphthyl]oxy}acetic acid,
- (60) 2-[5-(3-styrylsulfonylpropyl)-1-naphthyl]oxy}acetic acid,
- (61) 2-[5-[2-(2RS-hydroxy-3-(4-chlorophenoxy)propylthio)ethyl]-1-naphthyl]oxy}acetic acid,

- (62) 2-[5-[2-(2RS-hydroxy-3-(4-methylphenoxy)propylthio)ethyl]-1-naphthyl]oxy}acetic acid,
 (63) 2-[5-[2-(2RS-hydroxy-3-(4-methoxyphenoxy)propylthio)ethyl]-1-naphthyl]oxy}acetic acid,
 (64) 2-[5-[2-(2RS-hydroxy-3-diphenylmethoxypropylthio)ethyl]-1-naphthyl]oxy}acetic acid,
 (65) 2-[5-[2-(2RS-hydroxy-3-phenylthiopropylthio)ethyl]-1-naphthyl]oxy}acetic acid,
 (66) 2-[5-[2-(2RS-hydroxy-3-diphenylmethoxypropylthio)methyl]-1-naphthyl]oxy}acetic acid,
 (67) 1-cyanomethoxy-5-[2-(2RS-hydroxy-3-phenoxypropylthio)ethyl]naphthalene,
 (68) 1-cyanomethoxy-5-[2-(2RS-hydroxy-3-(4-chlorophenoxy)propylthio)ethyl]naphthalene,
 (69) 1-cyanomethoxy-5-[2-(2RS-hydroxy-3-(4-methylphenoxy)propylthio)ethyl]naphthalene,
 (70) 1-cyanomethoxy-5-[2-(2RS-hydroxy-3-(4-methoxyphenoxy)propylthio)ethyl]naphthalene,
 (71) 1-cyanomethoxy-5-[2-(2RS-hydroxy-3-diphenylmethoxypropylthio)ethyl]naphthalene,
 (72) 1-cyanomethoxy-5-[2-(2RS-hydroxy-3-phenylthiopropylthio)ethyl]naphthalene,
 (73) 1-cyanomethoxy-5-[2-(2RS-hydroxy-3-diphenylmethoxypropylthio)methyl]naphthalene,
 (74) 2-[5-[2-(2RS-hydroxy-3-(1-phenyl-1-(4-chlorophenyl)methoxy)propylthio)ethyl]-1-naphthyl]oxy}ethanol,
 (75) 2-[5-[2-(2RS-hydroxy-3-phenylaminopropylthio)ethyl]-1-naphthyl]oxy}ethanol,
 (76) 1-(tetrazol-5-ylmethoxy)-5-[2-(2RS-hydroxy-3-(4-methoxyphenoxy)propylthio)ethyl]naphthalene,
 (77) N-methyl-5-[2-(2RS-hydroxy-3-(1-phenyl-1-(4-chlorophenyl)methoxy)propylthio)methyl]-1-naphthyl]oxy}acetic acid amide,
 (78) 1-[2-[5-hydroxy-1-(1,2,3,4-tetrahydronaphthyl)]ethylthio]-3-phenoxy-2RS-propanol,
 (79) 2-[5-[2-(2RS-hydroxy-3-phenoxypropylthio)ethyl]-1-(5,6,7,8-tetrahydronaphthyl)]oxy}acetic acid methyl ester,
 (80) 2-[5-[2-(2RS-hydroxy-3-phenoxypropylthio)ethyl]-1-(5,6,7,8-tetrahydronaphthyl)]oxy}acetic acid or
 (81) 1-cyanomethoxy-5-[2-(2RS-hydroxy-3-phenoxypropylthio)ethyl]-5,6,7,8-tetrahydronaphthalene,

10) a compound described in 7), which is

- (1) 1-[2-(5-hydroxy-1-naphthyl)ethoxy]-3-phenoxy-2RS-propanol,
 (2) 2-[5-[2-(2RS-hydroxy-3-phenoxypropoxy)ethyl]-1-naphthyl]oxy}acetic acid methyl ester or
 (3) 2-[5-[2-(2RS-hydroxy-3-phenoxypropoxy)ethyl]-1-naphthyl]oxy}acetic acid,

11) a compound described in 8), which is

- (1) 1-[2-(5-hydroxy-1-naphthyl)ethylamino]-3-phenoxy-2RS-propanol or
 (2) 2-[5-[2-(2RS-hydroxy-3-phenoxypropylamino)ethyl]-1-naphthyl]oxy}acetic acid,

12) a pharmaceutical composition which comprises a naphthyl oxyacetic acid derivative of the formula (I) depicted in 1), non-toxic salt thereof, non-toxic acid addition salt thereof or their hydrate as an active ingredient, and

13) a pharmaceutical composition (PGE₂ antagonist or agonist) which comprises a naphthyl oxyacetic acid derivative of the formula (I) depicted in 1), non-toxic salt thereof, non-toxic acid addition salt thereof or their hydrate as an active ingredient.

Detailed description of the invention

In the formula (I), C1-4 alkyl represented by R¹, R², R³ and R⁴, or C1-4 alkyl represented as substituent of phenyl in M means methyl, ethyl, propyl, butyl and isomeric groups thereof.

In the formula (I), C1-4 alkylene in A means methylene, ethylene, trimethylene, tetramethylene and isomeric groups thereof.

In the formula (I), C1-6 alkylene represented by E and L means methylene, ethylene, trimethylene, tetramethylene, pentamethylene, hexamethylene and isomeric groups thereof.

In the formula (I), C1-4 alkoxy in M means methoxy, ethoxy, propoxy, butoxy and isomeric groups thereof.

In the formula (I), halogen in M means chlorine, bromine, fluorine and iodine.

In the formula (I), the side chain represented by -O-A may be connected with any carbon atom at 1st to 4th position, preferably, at 1st position.

In the formula (I), the side chain represented by -E-G-L-M may be connected with any carbon atom at 5th to 8th position, preferably, at 5th or 6th position.

Unless otherwise, specified all isomers are included in the invention. For example, alkyl, alkylene and alkenylene includes straight-chain or branched-chain ones. Double bond in alkenylene include structure of configurations E, Z and EZ mixtures. Isomers generated by asymmetric carbon(s) e.g. branched alkyl are also included in the present invention.

In addition, isomers generated by sulfinyl are also included in the present invention.

Salts

5 The compounds of the present invention of the formula (I) may be converted into the corresponding salts by known methods per se. Non-toxic and water-soluble salts are preferable. Suitable salts, for example, are as follows: salts of alkaline metals (potassium, sodium etc.), salts of alkaline earth metals (calcium, magnesium etc.), ammonium salts, salts of pharmaceutically acceptable organic amines (tetramethylammonium, triethylamine, methylamine, dimethylamine, cyclopentylamine, benzylamine, phenethylamine, piperidine, monoethanolamine, diethanolamine, tris(hydroxymethyl)aminomethane, lysine, arginine, N-methyl-D-glucamine etc.).

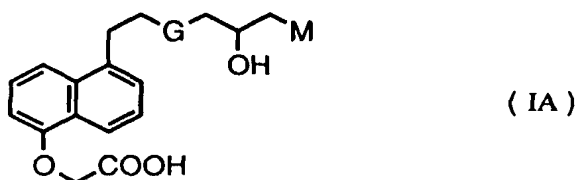
Acid addition salts

15 The compounds of the formula (I) may be converted into the corresponding acid addition salts by methods known per se. Non-toxic and water-soluble acid addition salts are preferable. Suitable acid addition salts, for example, are salts of inorganic acids, e.g., hydrochloride, hydrobromide, hydroiodide, sulphate, phosphate, nitrate etc., or salts of organic acids, e.g., acetate, trifluoroacetate, lactate, tartarate, oxalate, fumarate, maleate, citrate, benzoate, methanesulphonate, ethanesulphonate, benzenesulphonate, toluenesulphonate, isethioate, glucuronate, gluconate etc.

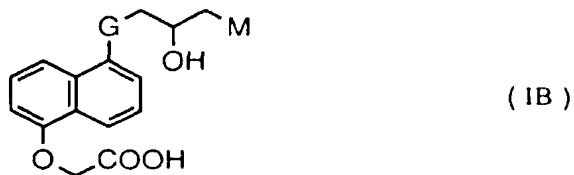
Preferable compound

In the compounds of the formula (I) of the present invention, the compounds wherein L is $-(CH_2)_m-CH=CH-(CH_2)_n-$ in which m and n are as hereinbefore defined, or $-(CH_2)_x-CH(OH)-(CH_2)_y-$ in which x and y are as hereinbefore defined, are preferable. The compounds wherein L is $-CH=CH-$ or $-CH_2-CH(OH)-CH_2-$, are more preferable.

25 Concretely, the following compounds are preferable. The compounds of the formula (IA)



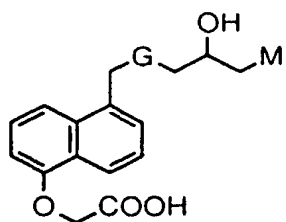
35 The compounds of the formula (IB)



45 The compounds of the formula (IC)

5

10

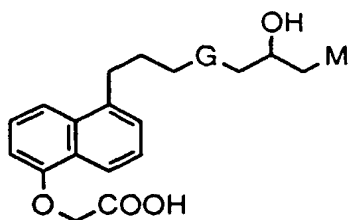


(IC)

15

The compounds of the formula (ID)

20

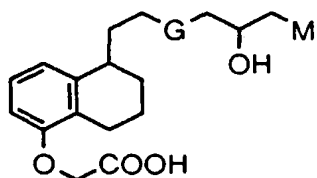


(ID)

25

The compounds of the formula (IE)

30

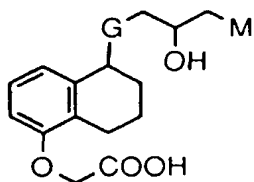


(IE)

35

40 The compounds of the formula (IF)

45



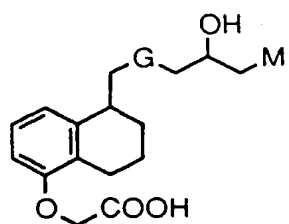
(IF)

50

The compounds of the formula (IG)

55

5

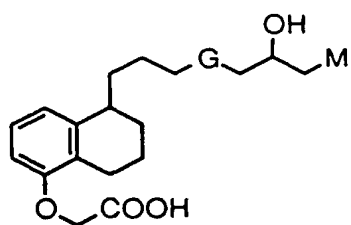


(IG)

10

The compounds of the formula (IH)

15



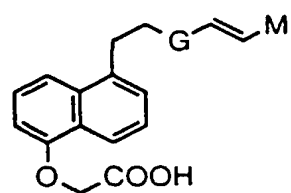
(IH)

20

25

The compounds of the formula (IJ)

30



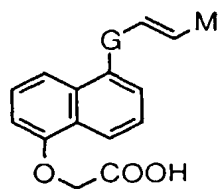
(IJ)

35

40

The compounds of the formula (IK)

45



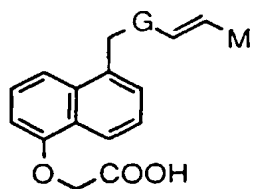
(IK)

50

The compounds of the formula (IL)

55

5

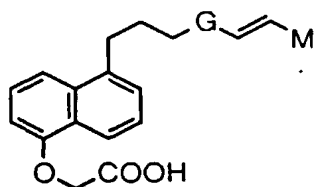


(IL)

10

The compounds of the formula (IM)

15



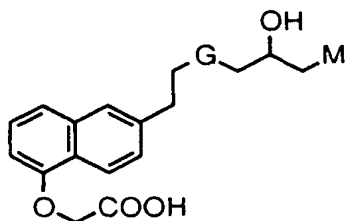
(IM)

20

25

The compounds of the formula (IN)

30



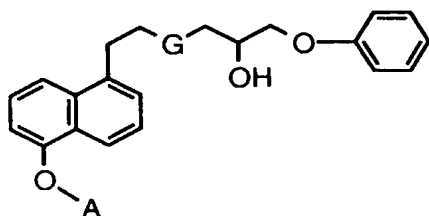
(IN)

35

40

The compounds of the formula (IO)

45



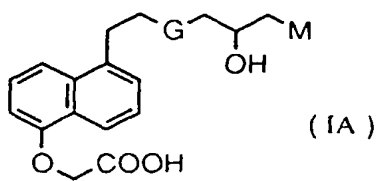
(IO)

50

In the formula (IA), (IB), (IC), (ID), (IE), (IF), (IG), (IH), (IJ), (IK), (IL), (IM), (IN) and (IO), all symbols are as herein-
before defined.

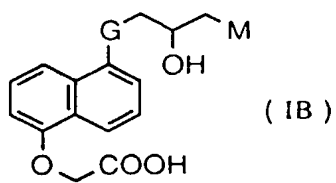
The compounds described in the Examples and the following compounds are preferable particularly.

EP 0 845 451 A1



No.	G	M
1	-S-	
2	-S-	
3	-S-	
4	-SO-	
5	-SO-	
6	-SO-	
7	-SO2-	
8	-SO2-	
9	-SO2-	
10	-NH-	

5



10

15

20

25

30

35

40

45

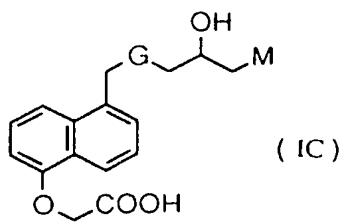
50

55

No.	G	M
1	-S-	
2	-S-	
3	-S-	
4	-SO-	
5	-SO-	
6	-SO-	
7	-SO2-	
8	-SO2-	
9	-SO2-	
10	-NH-	

EP 0 845 451 A1

5



10

15

20

25

30

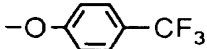
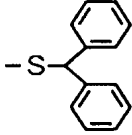
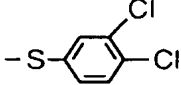


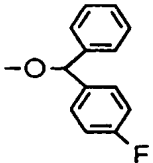

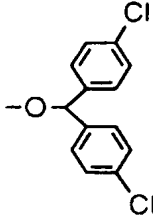
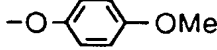
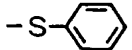
35

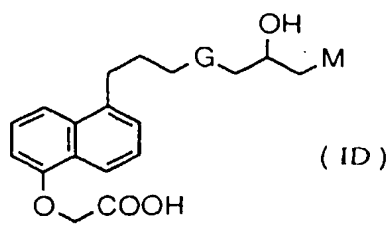
40

45

50

55

No.	G	M
1	-S-	
2	-S-	
3	-S-	
4	-SO-	
5	-SO-	
6	-SO-	
7	-SO ₂ -	
8	-SO ₂ -	
9	-SO ₂ -	
10	-NH-	



5

10

15

20

25

30

35

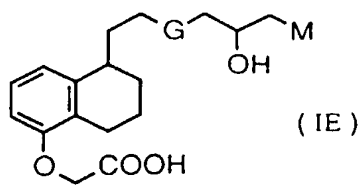
40

45

50

55

No.	G	M
1	-S-	
2	-S-	
3	-S-	
4	-SO-	
5	-SO-	
6	-SO-	
7	-SO ₂ -	
8	-SO ₂ -	
9	-SO ₂ -	
10	-NH-	



5

10

15

20

25

30

35

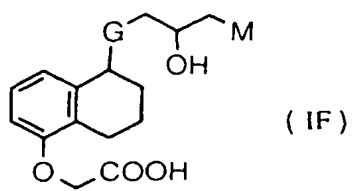
40

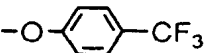
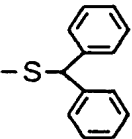
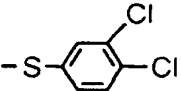


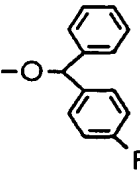

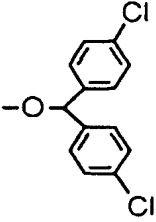
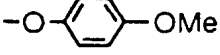
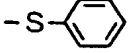
45

50

55

No.	G	M
1	-S-	
2	-S-	
3	-S-	
4	-SO-	
5	-SO-	
6	-SO-	
7	-SO ₂ -	
8	-SO ₂ -	
9	-SO ₂ -	
10	-NH-	



No.	G	M
1	-S-	
2	-S-	
3	-S-	
4	-SO-	
5	-SO-	
6	-SO-	
7	-SO ₂ -	
8	-SO ₂ -	
9	-SO ₂ -	
10	-NH-	

5

10

15

20

25

30

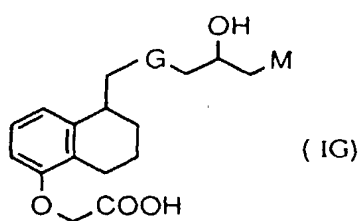
35

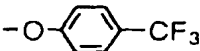
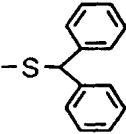
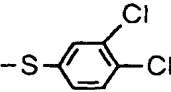


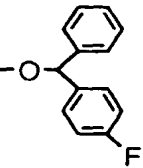

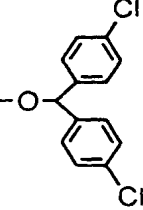
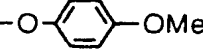
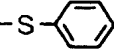
40

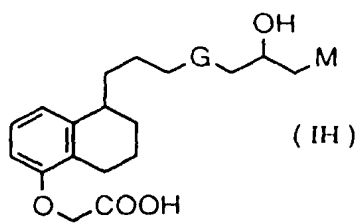
45

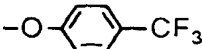
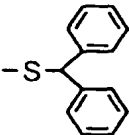
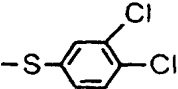


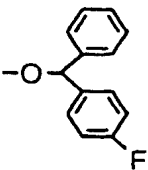

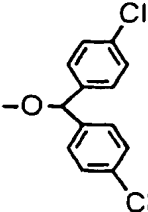
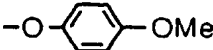
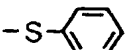
50

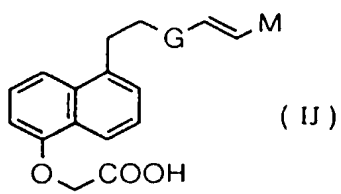
55

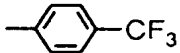
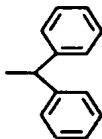
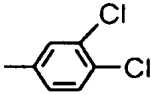
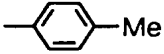
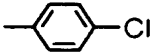
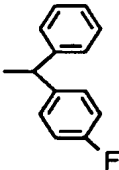
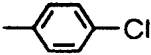
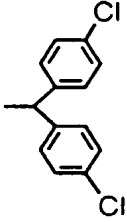
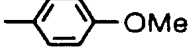
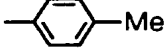


No.	G	M
1	-S-	
2	-S-	
3	-S-	
4	-SO-	
5	-SO-	
6	-SO-	
7	-SO ₂ -	
8	-SO ₂ -	
9	-SO ₂ -	
10	-NH-	

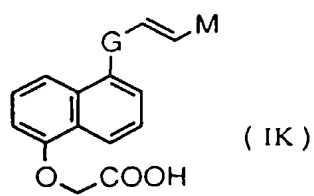


No.	G	M
1	-S-	
2	-S-	
3	-S-	
4	-SO-	
5	-SO-	
6	-SO-	
7	-SO ₂ -	
8	-SO ₂ -	
9	-SO ₂ -	
10	-NH-	



No.	G	M
1	-SO-	
2	-SO-	
3	-SO ₂ -	
4	-SO-	
5	-SO-	
6	-SO-	
7	-SO ₂ -	
8	-SO ₂ -	
9	-SO ₂ -	
10	-SO-	

5



10

15

20

25

30

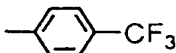
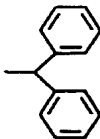
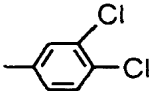
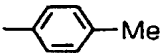
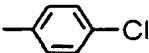
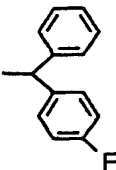
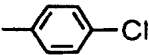
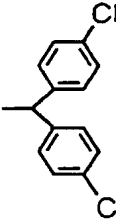
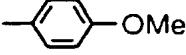
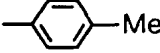
35

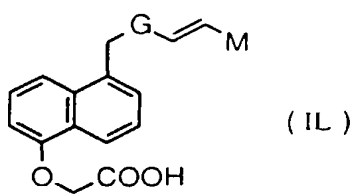
40

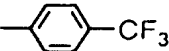
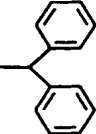
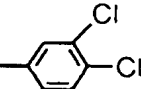
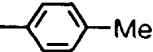
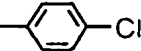
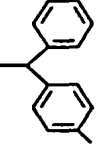
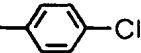
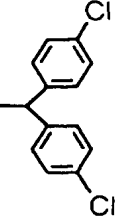
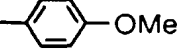
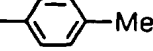
45

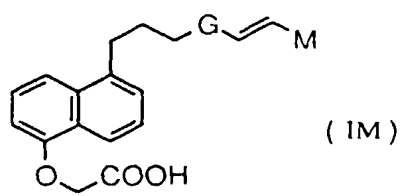
50

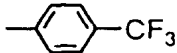
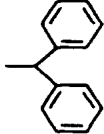
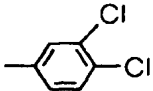
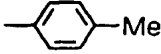
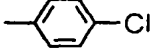
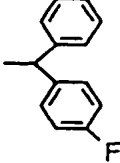
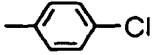
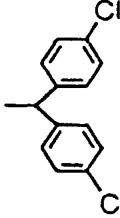
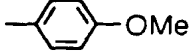
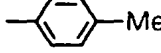
55

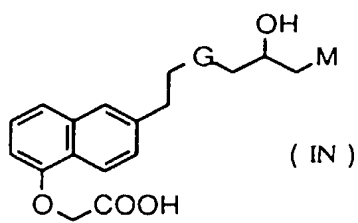
No.	G	M
1	-SO-	
2	-SO-	
3	-SO ₂ -	
4	-SO-	
5	-SO-	
6	-SO-	
7	-SO ₂ -	
8	-SO ₂ -	
9	-SO ₂ -	
10	-SO-	

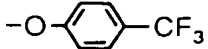
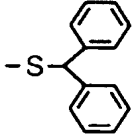
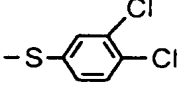


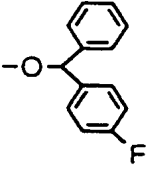

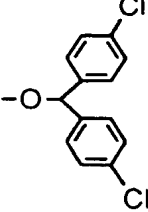
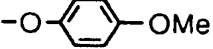
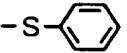


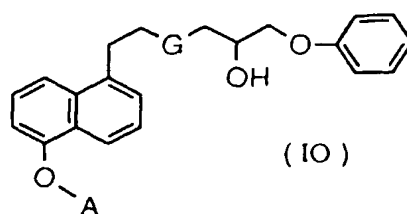
No.	G	M
1	-SO-	
2	-SO-	
3	-SO ₂ -	
4	-SO-	
5	-SO-	
6	-SO-	
7	-SO ₂ -	
8	-SO ₂ -	
9	-SO ₂ -	
10	-SO-	


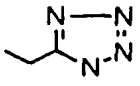
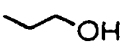

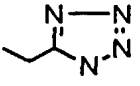


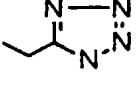

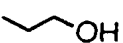



No.	G	M
1	-SO-	
2	-SO-	
3	-SO ₂ -	
4	-SO-	
5	-SO-	
6	-SO-	
7	-SO ₂ -	
8	-SO ₂ -	
9	-SO ₂ -	
10	-SO-	



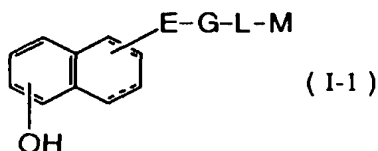
No.	G	M
1	-S-	
2	-S-	
3	-S-	
4	-SO-	
5	-SO-	
6	-SO-	
7	-SO ₂ -	
8	-SO ₂ -	
9	-SO ₂ -	
10	-NH-	



	No.	G	A
5	1	-S-	
10	2	-S-	
15	3	-S-	
	4	-SO-	
20	5	-SO-	
25	6	-SO-	
30	7	-SO ₂ -	
35	8	-SO ₂ -	
40	9	-SO ₂ -	
	10	-NH-	
45	11	-S-	

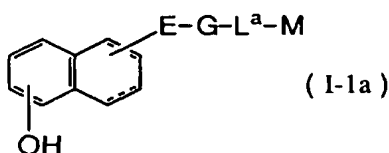
Method of preparation for the compounds of the present invention

In the compounds of the formula (I) of the present invention, the compounds of the formula (I-1)



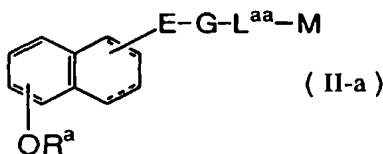
10 wherein all symbols are as hereinbefore defined may be prepared by the following methods (a)-(b).

(a) In the compounds of the formula (I-1) of the present invention, the compounds wherein L is $-(CH_2)_x-CH(OH)-(CH_2)_y-$ or C1-6 alkylene, i.e., the compounds of the formula (I-1a)



20

25 wherein L^a is $-(CH_2)_x-CH(OH)-(CH_2)_y-$ or C1-6 alkylene, and the other symbols are as hereinbefore defined may be prepared from the compounds of the formula (II-a)



40 wherein L^{aa} is $-(CH_2)_x-CH(OR^{aa})-(CH_2)_y-$ in which, R^{aa} is the protecting group which may be removed in an acidic condition, for example, tetrahydropyranyl etc., or C1-6 alkylene, R^a is the protecting group which may be removed in an acidic condition or an alkaline condition, for example, methoxymethyl or ethylcarbonate etc., and the other symbols are as hereinbefore defined, with the proviso that when nitrogen atom in G or M in the formula (I-1a) is free -NH group, NH group in the formula (II-a) is protected by the well-known protecting group (for example, benzyloxy-carbonyl (cbz), t-butoxycarbonyl (boc) or trifluoroacetyl (COCF₃) etc.)

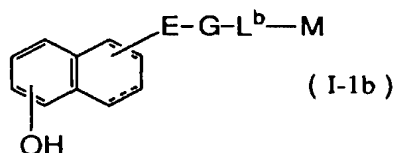
45 by removal of hydroxy-protecting group in an acidic condition, or removal of hydroxy-protecting group in an acidic condition and an alkaline condition two times, succeeding, (Which reaction may be started first.), if necessary, followed by removal of NH-protecting group.

50 This reaction may be carried out by known methods. For example, the removal of hydroxy-protecting group in an acidic condition may be carried out in a water-miscible organic solvent (methanol, ethanol, tetrahydrofuran (THF) etc.), by using organic acid (acetic acid, p-toluene sulfonic acid, trifluoro acetic acid or trichloro acetic acid etc.) or inorganic acid (hydrochloric acid or hydrobromic acid etc.), at 0-90°C. The removal of hydroxy-protecting group in an alkaline condition may be carried out in an organic solvent (methanol, ethanol, dimethoxyethane or mixture thereof etc.), using an aqueous solution of hydroxide of alkali (sodium hydroxide, potassium hydroxide etc.), hydroxide of alkaline-earth metals (calcium dihydroxide etc.) or carbonate (potassium carbonate etc.) at 0-50°C.

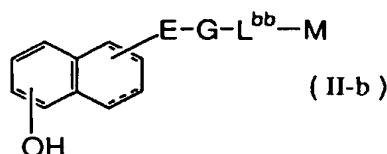
55 As for removal of NH-protecting group, for example, the removal of cbz group may be carried out under an atmosphere of hydrogen gas, in an organic solvent (methanol, ethanol or THF etc.), by using catalyst (Pd-C, Pd or Ni etc.), at 0-50°C. The removal of boc may be carried out in a water-miscible organic solvent (methanol, ethanol or THF etc.), by using organic acid (acetic acid, p-toluene sulfonic acid, trifluoro acetic acid or trichloro acetic acid etc.) or inorganic acid (hydrochloric acid or hydrobromic acid etc.), at 0-90°C. The removal of COCF₃ may be car-

ried out, for example, in a water-miscible organic solvent (methanol, ethanol, THF, dimethoxyethane or mixture thereof etc.), using an aqueous solution of hydroxide of alkali (sodium hydroxide, potassium hydroxide etc.), hydroxide of alkaline-earth metals (calcium dihydroxide etc.) or carbonate (potassium carbonate etc.) at 0-50°C.

(b) In the present invention compounds of the formula (I-1), the compounds wherein L is $-(CH_2)_m-CH=CH-(CH_2)_n-$, i.e., the compounds of the formula (I-1b)



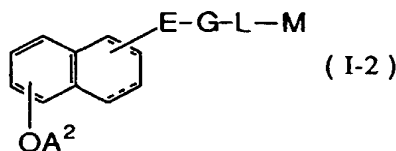
wherein L^b is $-(CH_2)_m-CH=CH-(CH_2)_n-$, and the other symbols are as hereinbefore defined may be prepared from the compounds of the formula (II-b)



wherein L^{bb} is $-(CH_2)_m-CH_2CH(OR^b)-(CH_2)_n-$ in which, R^b is the well-known elimination group (for example, mesyl or tosyl group etc.), and the other symbols are as hereinbefore defined, with the proviso that when nitrogen atom in G or M in the formula (I-1b) is free -NH group, NH group in the formula (II-b) is protected by the well-known protecting group (for example, cbz, boc or $COCF_3$ etc.) by removal of elimination group, if necessary, followed by removal of NH-protecting group.

This reaction may be carried out in an organic solvent (methanol or ethanol etc.) by adding base (potassium hydroxide, sodium hydroxide or triethylamine etc.) at 0-100°C. The removal of NH-protecting group may be carried out by the method described hereinbefore.

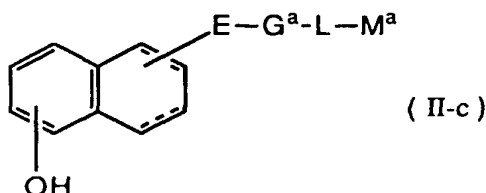
In the compound of the formula (I) of the present invention, the compounds of the formula (I-2) of the present invention



wherein A^2 is as A other than hydrogen

may be prepared by reacting the compounds, in which nitrogen atom in G or M in the formula (I-1) is free -NH group, NH group is protected by the well-known protecting group (for example, cbz, boc or $COCF_3$ etc.), i.e. the compounds of the formula (II-c)

5



10

wherein G^a and M^a are as G and M , respectively, with the proviso that when nitrogen atom in G or M in the formula (I-2) is free -NH group, NH group is protected by the well-known protecting group (for example, cbz, boc or COCF_3 etc.) and the other symbols are as hereinbefore defined with the compounds of the formula (III)

15



wherein X^2 is halogen and A^{2a} is

20

- (i) -(C1-4 alkylene)- COOR^{1a} in which R^{1a} is C1-4 alkyl,
- (ii) -(C1-4 alkylene) - OR^5 , in which R^5 is tetrahydropyranyl,
- (iii) -(C1-4 alkylene) - CONR^2R^3 ,
- (iv) -(C1-4 alkylene)-tetrazolyl or
- (v) -(C1-4 alkylene)-CN,

25

and the other symbols are as hereinbefore defined, with the proviso that when nitrogen atom in A^{2a} is free -NH group, NH group is protected by the well-known protecting group (for example, cbz, boc or COCF_3 etc.), if necessary, followed by hydrolysis in an alkaline condition or by removal of protecting group.

30

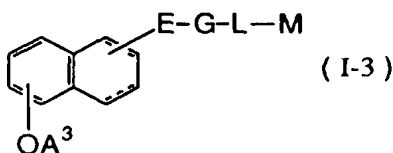
The above mentioned O-alkylation is known, and for example, this reaction may be carried out in a water-miscible organic solvent (acetone, THF or methylene chloride etc.) in the presence of a base (potassium carbonate etc.), at 0-50°C.

The hydrolysis in an alkaline condition is well known. For example, this reaction may be carried out in a water-miscible organic solvent (methanol, ethanol, dimethoxyethane or mixture thereof etc.), using an aqueous solution of hydroxide of alkali (sodium hydroxide, potassium hydroxide etc.), hydroxide of alkaline-earth metals (calcium dihydroxide etc.) or carbonate (potassium carbonate etc.) at 0-50°C. The removal of protecting group may be carried out by the method described hereinbefore.

35

In the compounds of the formula (I) of the present invention, the compounds wherein A is -(C1-4 alkylene)-tetrazol-5-yl, i.e. the compounds of the formula (I-3)

40

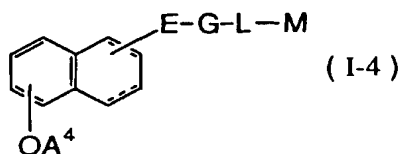


45

50

in which, A^3 is -(C1-4 alkylene)-tetrazol-5-yl and the other symbols are as hereinbefore defined may be also prepared by reacting the compounds of the formula (I-4)

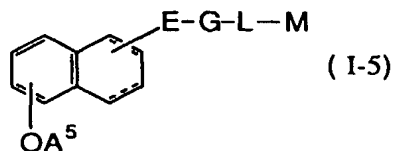
55



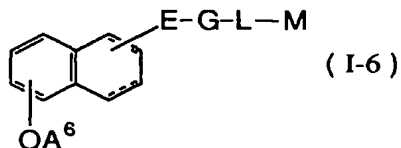
10 in which A^4 is $-(C1-4 \text{ alkylene})-CN$ and the other symbols are as hereinbefore defined with the azide.

The reaction to introduce a tetrazol-5-yl group from cyano group with an azide are known, it may be carried out, for example, on anhydrous condition, using with azide (sodium azide, lithium azide, potassium azide etc.) in the presence of weak acid (pyridium chloride, ammonium chloride, dimethylaniline hydrochloride etc.) in an inert organic solvent (DMF, N-methylpyrrolidone etc.) with heating.

15 In the compounds of the formula (I) of the present invention, the compounds wherein A is $-(C1-4 \text{ alkylene})-CONR^2R^3$, i.e. the compounds of the formula (I-5)



in which, A^5 is $-(C1-4 \text{ alkylene})-CONR^2R^3$ in which R^2 and R^3 are as hereinbefore defined and the other symbols are as hereinbefore defined may be also prepared by reacting the compounds of the formula (I-6)



in which A^6 is $-(C1-4 \text{ alkylene})-COOR^{1a}$ in which R^{1a} is as hereinbefore defined and the other symbols are as hereinbefore defined with the compounds of the formul

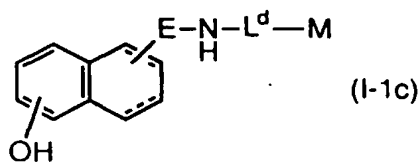


in which all symbols are as hereinbefore defined.

45 The above reaction to form an amide bond is well known. For example, this reaction may be carried out in inert organic solvent (benzene, toluene or methylene chloride etc.), or in the absence of solvent, using tertiary amine (pyridine or triethylamine etc.) at $0-50^\circ\text{C}$, or it may be carried out in an organic solvent (methylene chloride or THF etc.), using a corresponding base, in the presence or absence of corresponding condensing agents (2-chloro-N-methylpyridinium iodide etc.) at $0-40^\circ\text{C}$.

50 The compounds of the formula (II-a) and (II-b) may be prepared by the known reaction. For example, these compounds may be prepared according to the method shown in the reaction scheme (1), (2), (3) or (4) or method described in Example.

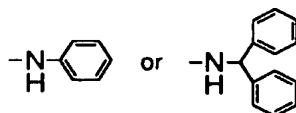
In the compounds of the formula (I-1) of the present invention, the compounds wherein G is $-NH-$ and L is $-CH_2-CH(OH)-(CH_2)_y-$, i.e. the compounds of the formula



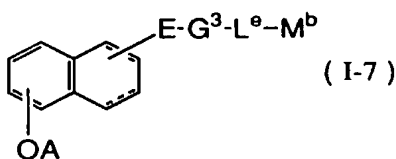
10 in which L^d is $-\text{CH}_2-\text{CH}(\text{OH})-(\text{CH}_2)_y-$ in which y is as hereinbefore defined and the other symbols are as hereinbefore defined

may be also prepared according to the method shown in the reaction scheme (5) or method described in Example.

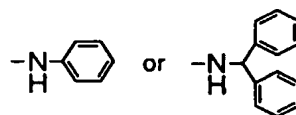
15 In the compounds of the formula (I) of the present invention, the compounds wherein M is



in which each phenyl may be substituted by the substituent described hereinbefore and L is $-(\text{CH}_2)_x-\text{CH}(\text{OH})-(\text{CH}_2)_y-$, i.e. the compounds of the formula



35 in which M^b is



45 in which each phenyl may be substituted by the substituent described hereinbefore, L^e is $-(\text{CH}_2)_x-\text{CH}(\text{OH})-(\text{CH}_2)_y-$ in which x and y are as hereinbefore defined, G^3 is $-\text{S}-$, $-\text{O}-$ or $-\text{NR}^4-$ and the other symbols are as hereinbefore defined may be also prepared according to the method shown in the reaction scheme (6) or method described in Example.

In reaction scheme (1), (2), (3), (4), (5) and (6) each symbol means the following definition or is as defined hereinbefore.

50 Et is ethyl,
Ac is acetyl,
iPr is isopropyl.

Ph is phenyl,

MOM is methoxymethyl,

55 9-BBN is 9-borabicyclo[3.3.1]nonane,

LAH is lithium aluminum hydride,

TsCl is tosylchloride,

AcSK is potassium thioacetate,

mCPBA is methachloroperbenzoic acid,

cbz is benzyloxycarbonyl,

L^c is L^{aa}, L^{bb} or C1-6 alkylene,

E^c is C1-6 alkylene,

G¹ is -O-, -S-, -SO-, or -SO₂-,

G² is -NR⁴-,

Bu₄NBr is tetrabutylammonium bromide,

Py is pyridine,

R^d is

1) acetyl or hydrogen when G³ is -S-,

2) hydrogen when G³ is -O- or NR^{4a}- in which R^{4a} is C1-4 alkyl,

3) NH-protecting group as defined hereinbefore when G³ is -NH-Z is NH-protecting group as defined hereinbefore and

Ph^a is phenyl may be substituted by 1-3 of C1-4 alkyl, C1-4 alkoxy, halogen, nitro or trifluoromethyl.

The compounds of the formula (II-a) are a part of the compounds of the formula (VII).

The compounds of the formula (II-b) are a part of the compounds of the formula (VIII). The compounds of the formula (IV), (V-O) or (VI) as starting materials may be prepared by the known methods. For example, these compounds may be prepared by the methods described in Example in the present specification.

In each reaction in the present specification, obtained products may be purified by conventional techniques. For example, purification may be carried out by distillation at atmospheric or reduced pressure, by high performance liquid chromatography, by thin layer chromatography or by column chromatography using silica gel or magnesium silicate, by washing or by recrystallization. Purification may be carried out after each reaction, or after a series of reactions.

The other starting materials and reagents in the present invention are known per se or may be prepared by known methods.

Reaction Scheme 1

5

10

15

20

25

30

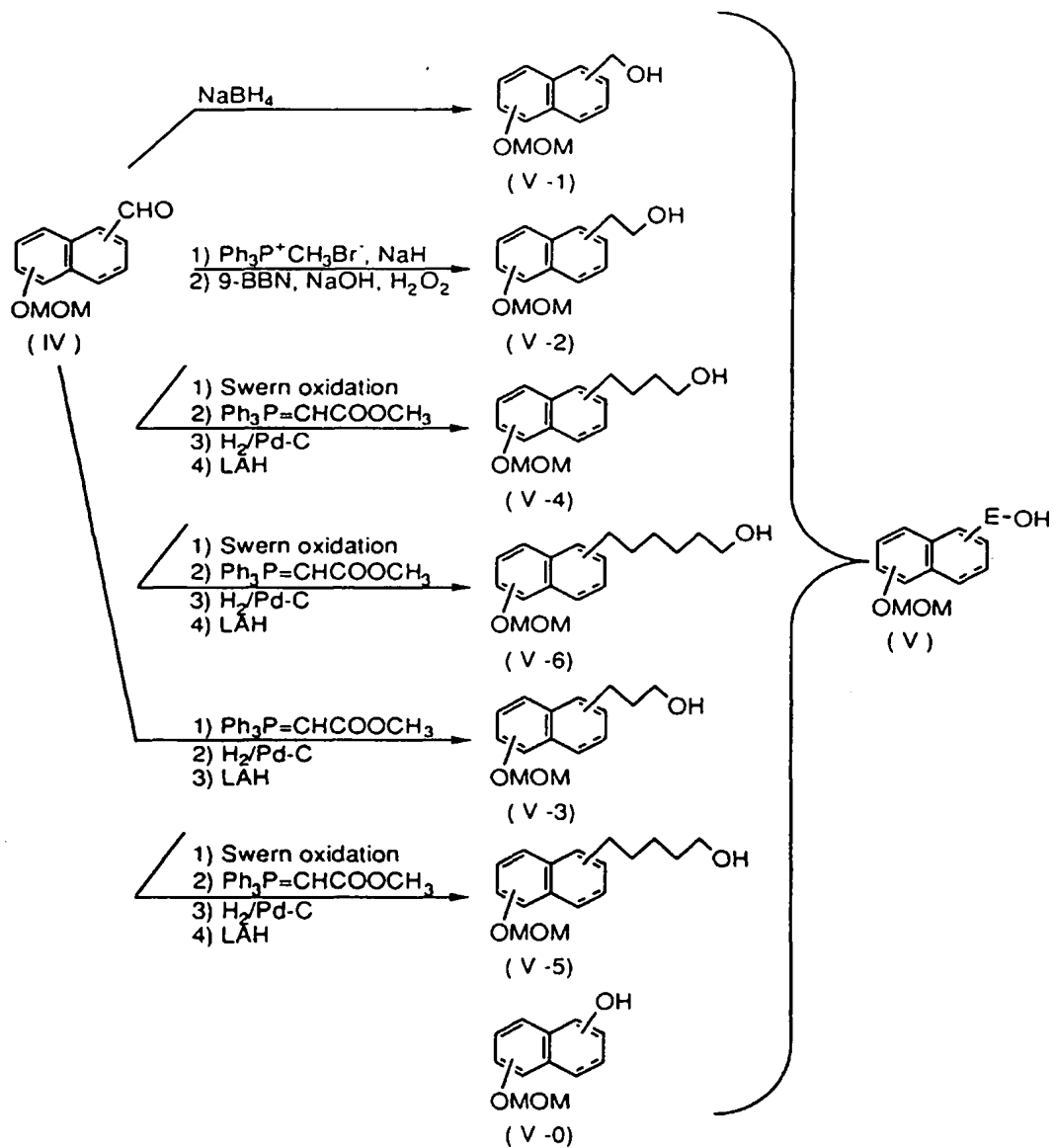
35

40

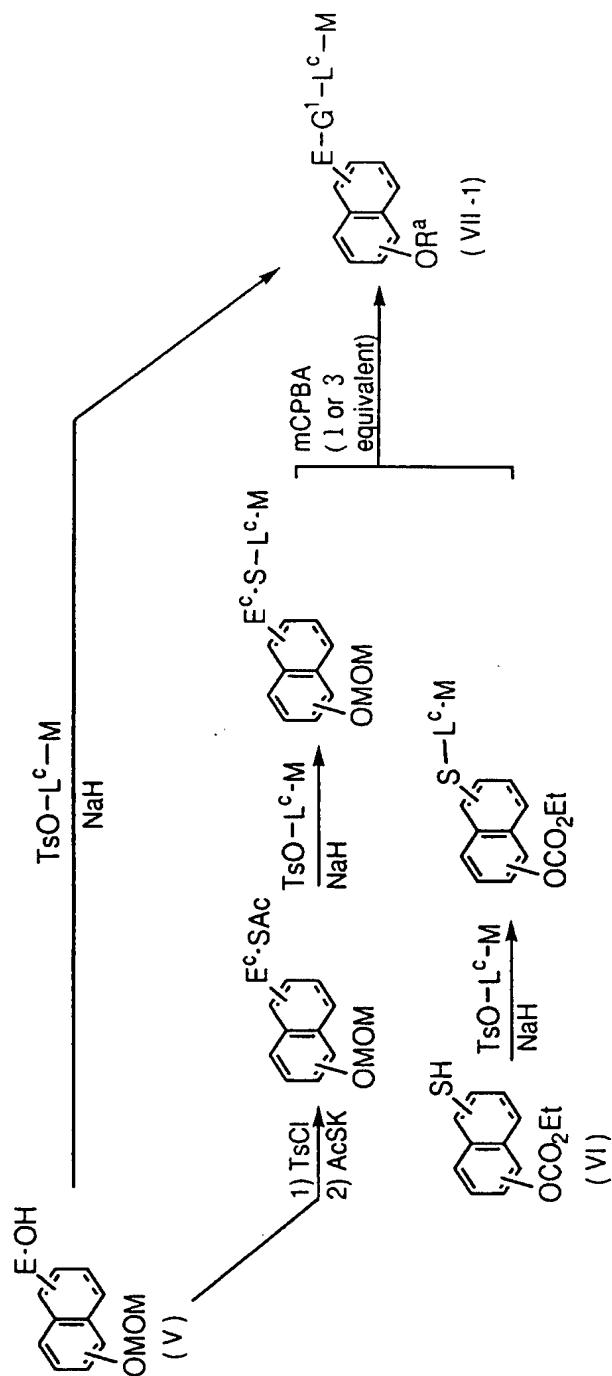
45

50

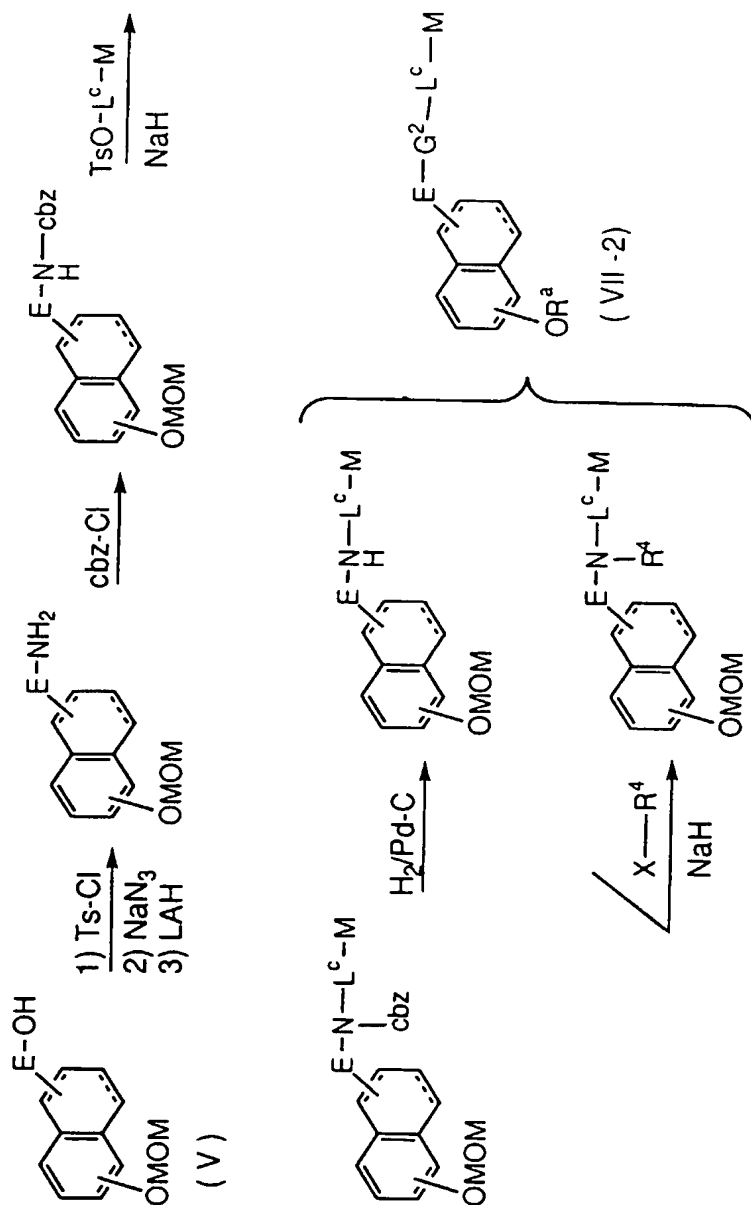
55



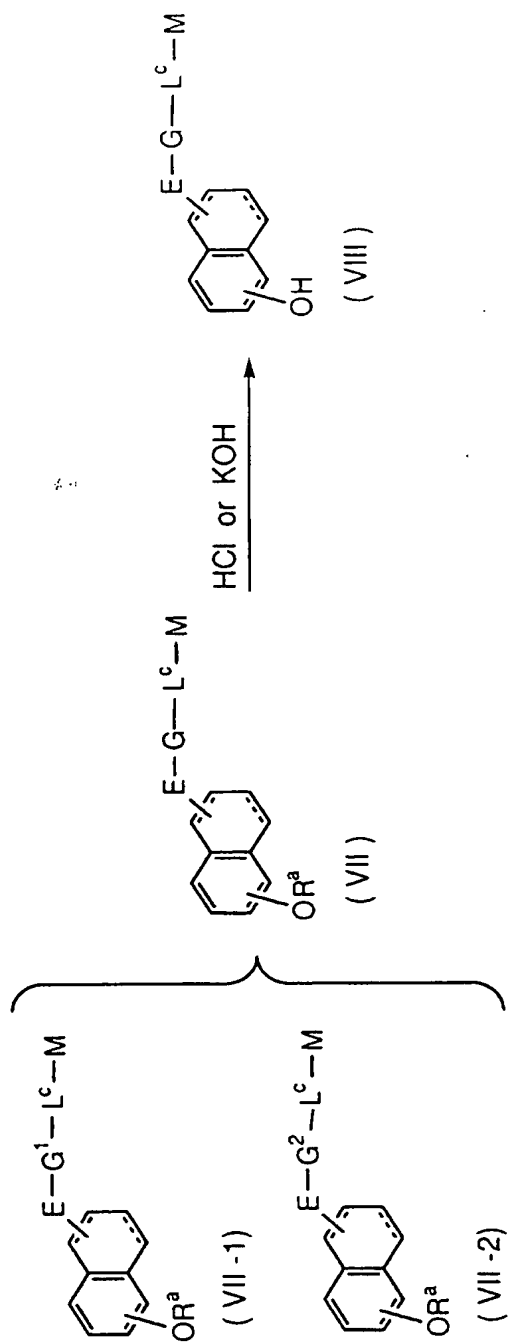
Reaction Scheme 2



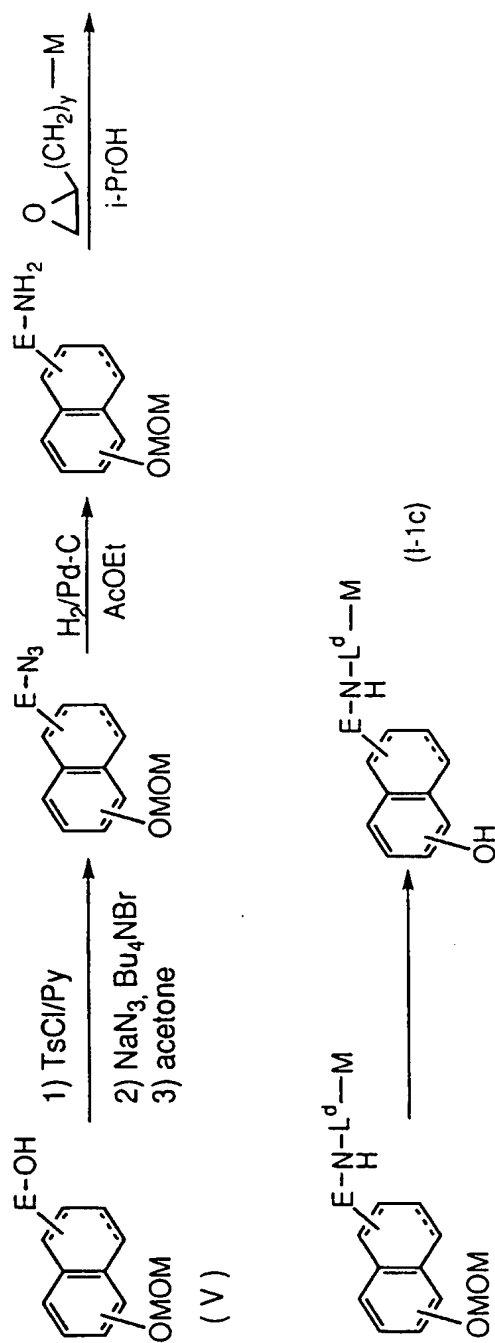
Reaction Scheme 3



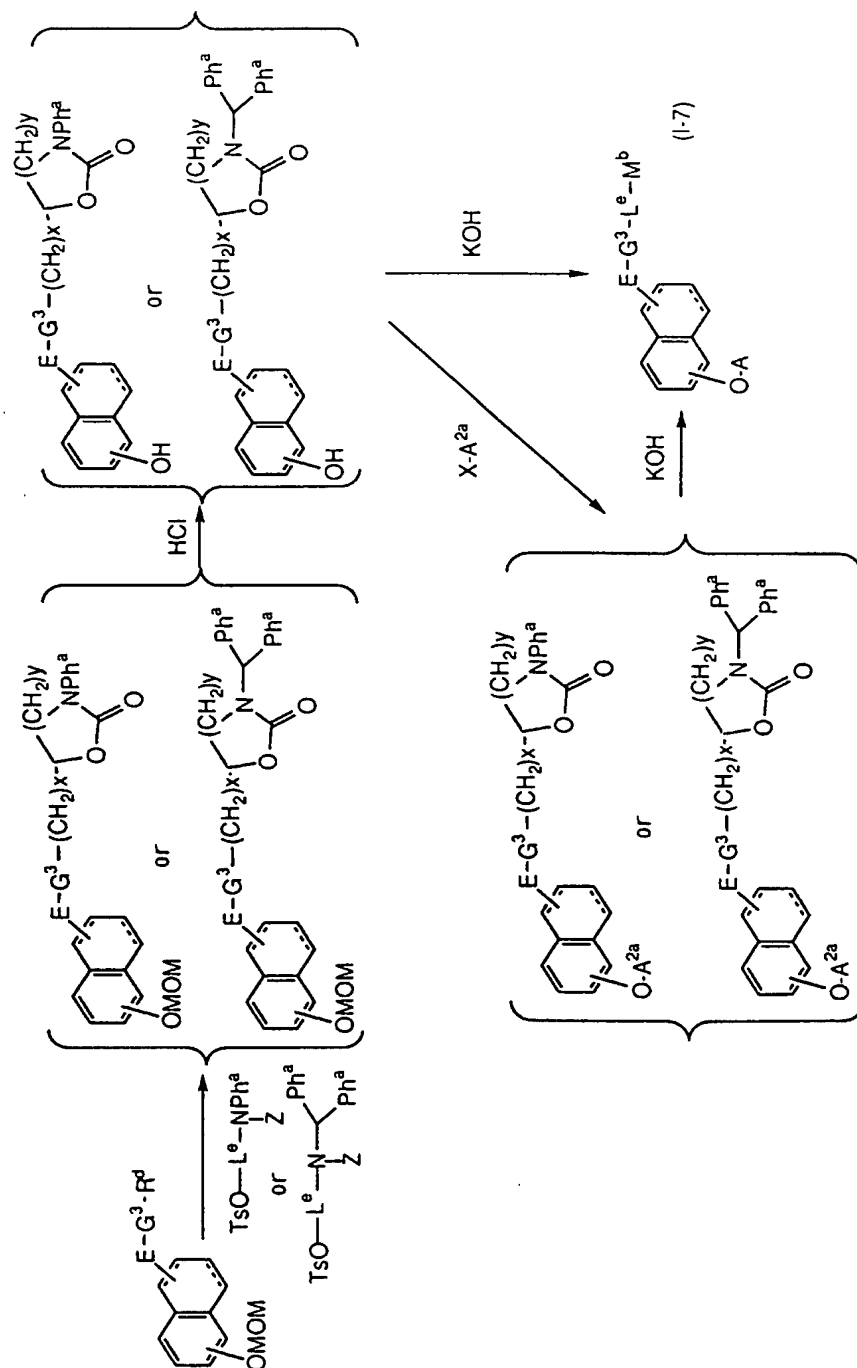
Reaction Scheme 4



Reaction Scheme 5



Reaction Scheme 6



Industrial availabilityPharmacological Activities

5 The compounds of the present invention of the formula (I) are useful as PGE₂ antagonists or agonists, because they can bind onto prostaglandin E₂ receptors and have antagonist or agonist activity against the action thereof.

As mentioned hereinbefore, to antagonize PGE₂ receptor is linked to inhibition of diuresis, to inhibition of hyperlipemia, to inhibition of reduction of blood sugar, to inhibition of uterine contraction, to analgesic action, to inhibition of digestive peristalsis, to induction of sleep. Therefore, PGE₂ antagonists are considered to be useful for anti-hyperlipemia, for the prevention of abortion, as analgesics, or as antidiarrheals or sleep inducers.

As mentioned hereinbefore, to agonize for PGE₂ receptor is linked to promotion of diuresis, to promotion of hyperlipemia, to promotion of reduction of blood sugar, to uterine contraction, to promotion of digestive peristalsis, to suppression gastric acid secretion or to reduction of blood pressure. Therefore, PGE₂ receptor agonists are considered to be useful as diuretic, anti-diabetes, abortifacient, cathartic, antiulcer, anti-gastritis or antihypertensive agents.

15 For example, in standard laboratory test, the effects of the compounds of the present invention were confirmed by inhibitory effect on binding PGE₂ using expression cell of receptor.

(I) Binding assay using expression cell of prostanoide receptor subtype

20 The preparation of membrane fraction was carried out according to the method of Sugimoto et al (J. Biol. Chem. 267, 6463-6466 (1992)), using expression CHO cell of prostanoide receptor subtype (mouse EP_{3α}).

The standard assay mixture contained membrane fraction (0.5 mg/ml), [³H]-PGE₂ in a final volume of 200 ml was incubated for 1 hour at room temperature. The reaction was terminated by addition of 3 ml of ice-cold buffer. The mixture was rapidly filtered through a glass filter (GF/B). The radioactivity associated with the filter was measured by liquid scintillation counting.

Kd and Bmax values were determined from Scatchard plots (Ann. N.Y. Acad. Sci., 51, 660 (1949)). Non-specific binding was calculated as the bond in the presence of an excess (2.5 nM) of unlabeled PGE₂. In the experiment for competition of specific [³H]-PGE₂ binding by the compounds of the present invention, [³H]-PGE₂ was added at a concentration of 2.5 nM and the compounds of the present invention were at a concentration of 1 mM. Buffer : 10 mM potassium phosphate (pH6.0), 1 mM EDTA, 10 mM MgCl₂, 0.1M NaCl.

30 The dissociation constant Ki (μM) of each compound was calculated by the following equation.

$$K_i = IC_{50} / (1 + ([C]/K_d))$$

35 The results were shown as follows.

Example No.	dissociation constant Ki (μM)
3	0.048
3 (2)	0.0099
3 (6)	0.15
3 (8)	2.0
5	0.080
5 (1)	0.0086

Toxicity

55 The toxicity of the compounds of the present invention is very low and therefore, it is confirmed that these compounds are safe for use as medicine.

Application for Pharmaceuticals

The compounds of the formula (I) of the present invention are useful for PGE₂ antagonists or agonists, because they can bind onto PGE₂ receptors and have an activity to antagonize or agonize for the action thereof.

As mentioned hereinbefore, to antagonize PGE₂ is linked to inhibition of hyperlipemia, to inhibition of uterine contraction, to analgesic action, to inhibition of digestive peristalsis or to induction of sleep. Therefore, PGE₂ antagonists are considered to be useful for anti-hyperlipemia, for the prevention of abortion, as analgesics, or as antidiarrheals or sleep inducers.

As mentioned hereinbefore, to agonize PGE₂ is linked to promotion of diuresis, to promotion of reduction of blood sugar, to uterine contraction, to promotion of digestive peristalsis, to suppression of gastric acid secretion or to reduction of blood pressure. Therefore, PGE₂ agonists are useful as diuretic, anti-diabetes, abortifacient, cathartic, antiulcer, anti-gastritis or antihypertensive agents.

For the purpose above described, the compounds of the formula (I), non-toxic salts thereof and hydrates thereof may be normally administered systematically or partially, usually by oral or parenteral administration.

The doses to be administered are determined depending upon age, body weight, symptom, the desired therapeutic effect, the route of administration, and the duration of the treatment etc. In the human adult, the doses per person per dose are generally between 1 µg and 100 mg, by oral administration, up to several times per day, and between 0.1 µg and 10 mg, by parenteral administration (preferred into vein) up to several times per day, or continuous administration between 1 and 24 hours per day into vein.

As mentioned above, the doses to be used depend upon various conditions. Therefore, there are cases in which doses lower than or greater than the ranges specified above may be used.

On administration of the compounds of the present invention, it is used as solid compositions, liquid compositions or other compositions for oral administration, as injections, liniments or suppositories etc. for parenteral administration.

Solid compositions for oral administration include compressed tablets, pills, capsules, dispersible powders, and granules etc.

Capsules contain hard capsules and soft capsules.

In such solid compositions, one or more of the active compound(s) is or are, admixed with at least one inert diluent such as lactose, mannitol, mannit, glucose, hydroxypropyl cellulose, microcrystalline cellulose, starch, polyvinylpyrrolidone, magnesium metasilicate aluminate. The compositions may also comprise, as is normal practice, additional substances other than inert diluents: e.g. lubricating agents such as magnesium stearate, disintegrating agents such as cellulose calcium glycolate, and assisting agents for dissolving such as glutamic acid or asparaginic acid. The tablets or pills may, if desired, be coated with film of gastric or enteric material such as sugar, gelatin, hydroxypropyl cellulose or hydroxypropyl cellulose phthalate etc., or be coated with two or more films. And further, coating may include containment within capsules of absorbable materials such as gelatin.

Liquid compositions for oral administration include pharmaceutically-acceptable emulsions, solutions, syrups and elixirs etc. In such liquid compositions, one or more of the active compound(s) is or are comprised in inert diluent(s) commonly used in the art (for example, purified water, ethanol etc.). Besides inert diluents, such compositions may also comprise adjuvants such as wetting agents, suspending agents, sweetening agents, flavouring agents, perfuming agents and preserving agents.

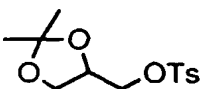
Other compositions for oral administration include spray compositions which may be prepared by known methods and which comprise one or more of the active compound(s). Spray compositions may comprise additional substances other than inert diluents: e.g. stabilizing agents such as sodium hydrogen sulfate, stabilizing agents to give the title compound isotonicity, isotonic buffer such as sodium chloride, sodium citrate, citric acid. For preparation of such spray compositions, for example, the method described in the United States Patent No. 2868691 or 3095355 may be used.

Injections for parenteral administration include sterile aqueous or non-aqueous solutions, suspensions and emulsions. Aqueous solutions or suspensions include distilled water for injection and physiological salt solution. Non-aqueous solutions or suspensions include propylene glycol, polyethylene glycol, plant oil such as olive oil, alcohol such as ethanol, POLYSORBATE80 (registered trade mark) etc. Such compositions may comprise additional diluents: e.g. preserving agents, wetting agents, emulsifying agents, dispersing agents, stabilizing agent, assisting agents such as assisting agents for dissolving (for example, glutamic acid, asparaginic acid). They may be sterilized for example, by filtration through a bacteria-retaining filter, by incorporation of sterilizing agents in the compositions or by irradiation. They also be manufactured in the form of sterile solid compositions and which can be dissolved in sterile water or some other sterile diluents for injection immediately before used.

Other compositions for parenteral administration include liquids for external use, and endemic liniments, ointment, suppositories and pessaries which comprise one or more of the active compound(s) and may be prepared by known methods.

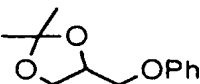
Best mode to practice the invention

The following reference examples and examples are intended to illustrate, but not limit, the present invention. The solvents in parentheses show the developing or eluting solvents and the ratios of the solvents used are by volume in chromatographic separations. The symbol in the structure is as defined hereinbefore.

Reference Example 1

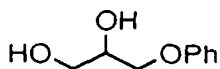
To a solution of 2,2-dimethyl-1,3-dioxolane-4-methanol (50 g) and pyridine (50 ml) in methylene chloride (200 ml), tosylchloride (76.3 g) in methylene chloride (150 ml) was added dropwise at -20°C. The mixture was stirred for 1 hour at room temperature. The reaction mixture was added to 2N aqueous solution of hydrochloric acid (300 ml) and extracted by ethyl acetate. The organic layer was washed with water and a saturated aqueous solution of sodium chloride, dried over with anhydrous magnesium sulfate and concentrated. The residue was purified on silica gel column chromatography (hexane : AcOEt=3 : 1) to give the title compound (95.8 g) having the following physical data.

TLC : Rf 0.21 (hexane : AcOEt=3 : 1);
MS (EI) : m/z 271 (M⁺-CH₃).

Reference Example 2

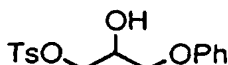
A suspension of sodium hydride (1.47 g) in dimethylformamide (DMF) (20 ml) was cooled to 0°C. The solution of phenol (3.45 g) in DMF (20 ml) was added dropwise to the suspension. The mixture was stirred for 1 hour at room temperature. To the mixture, the solution of the compound prepared in Reference Example 1 (10 g) in DMF (20 ml) was added. The mixture was stirred for 2 hours at 80°C. The reaction mixture was cooled to room temperature, poured into iced water and extracted with ether two times. The organic layer was washed with water and a saturated aqueous solution of sodium chloride, dried over with anhydrous magnesium sulfate and concentrated. The residue was purified on silica gel column chromatography (hexane : AcOEt=9 : 1) to give the title compound (6.53 g) having the following physical data.

TLC : Rf 0.22 (hexane : AcOEt=9 : 1);
MS (EI) : m/z 208 (M⁺), 193.

Reference Example 3

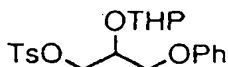
To a solution of the compound prepared in Reference Example 2 (6.37 g) in methanol (30 ml), 2N aqueous solution of hydrochloric acid (3 ml) was added. The mixture was refluxed for 2 hours. The reaction mixture was cooled to room temperature, diluted with ethyl acetate and washed with saturated aqueous solution of sodium hydrogen carbonate. The organic layer was dried over with anhydrous magnesium sulfate and concentrated to give the title compound (5.14 g) having the following physical data.

TLC : Rf 0.40 (AcOEt);
MS (EI) : m/z 168 (M^+).

Reference Example 4

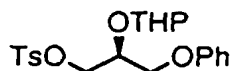
To a solution of the compound prepared in Reference Example 3 (3.5 g) in pyridine (10 ml), the solution of tosylchloride (8 g) in methylene chloride (10 ml) was added at -20°C . The mixture was stirred for 1 hour at room temperature. The reaction mixture was poured into 2N aqueous solution of hydrochloric acid and extracted with ethyl acetate. The organic layer was washed with water and a saturated aqueous solution of sodium chloride, dried over with anhydrous magnesium sulfate and concentrated. The residue was purified on silica gel column chromatography (AcOEt : $\text{CH}_2\text{Cl}_2=1 : 49$) to give the title compound (4.96 g) having the following physical data.

TLC : Rf 0.31 (hexane : AcOEt=3 : 2);
MS (EI) : m/z 322 (M^+).

Reference Example 5

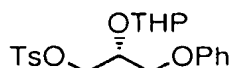
To a solution of the compound prepared in Reference Example 4 (9.88 g) and pyridium p-toluene sulfate (100 mg) in methylene chloride (60 ml), dihydropyran (5.58 ml) was added dropwise at 0°C . The mixture was stirred for 6 hours at room temperature. Triethylamine (0.2 ml) was added to the mixture. The solvent was distilled off. The residue was purified on silica gel column chromatography (hexane : AcOEt=41 : 9) to give the title compound (11.79 g) having the following physical data.

TLC : Rf 0.28 (hexane : AcOEt=4 : 1);
MS (EI) : m/z 406 (M^+).

Reference Example 6

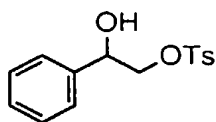
10 By using (S)-(+)-2,2-dimethyl-1,3-dioxolane-4-methanol instead of 2,2-dimethyl-1,3-dioxolane-4-methanol as starting material, the title compound having the following physical data was obtained by the same procedure as Reference Example 1 → Reference Example 2 → Reference Example 3 → Reference Example 4 → Reference Example 5.

15 TLC : Rf 0.28 (hexane : AcOEt=4 : 1);
MS (EI) : m/z 406 (M⁺).

Reference Example 6(1)

25 By using (R)-(-)-2,2-dimethyl-1,3-dioxolane-4-methanol instead of 2,2-dimethyl-1,3-dioxolane-4-methanol as starting material, the title compound having the following physical data was obtained by the same procedure as Reference Example 6.

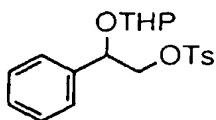
30 TLC : Rf 0.28 (hexane : AcOEt=4 : 1);
MS (EI) : m/z 406 (M⁺).

Reference Example 7

45 To a solution of 1-phenyl-1,2-ethandiol (13.82 g) in pyridine (50 ml), tosylchloride (21 g) was added for 30 minutes at -20°C. The reaction mixture was stirred for 30 minutes at -20°C and, succeedingly, stirred for 16 hours at room temperature. The reaction mixture was poured into iced water and extracted with ether. The organic layer was washed with
50 2N aqueous solution of hydrochloric acid, water and saturated aqueous solution of sodium hydrogen carbonate, succeedingly, dried over with anhydrous sodium sulphate and concentrated. The residue was purified on silica gel column chromatography (hexane : AcOEt=3 : 1) to give the title compound (18.56 g) having the following physical data.

55 TLC : Rf 0.41 (hexane : AcOEt=2 : 1);
MS (EI) : m/z 292 (M⁺).

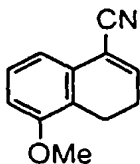
Reference Example 8



To a solution of compound prepared in Reference Example 7 (10 g) in methylene chloride (100 ml), dihydropyran (5.76 g) was added dropwise at room temperature. P-toluene sulfonic acid (catalytic amount) was added to the mixture. The mixture was stirred overnight at room temperature. To the reaction mixture, triethylamine (two drops) was added. The mixture was concentrated. The residue was dissolved in ethyl acetate. The organic layer was washed with water and a saturated aqueous solution of sodium chloride, dried over with anhydrous sodium sulfate and concentrated to give the title compound (12.9 g) having the following physical data.

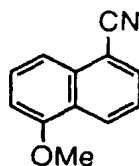
TLC : Rf 0.50 (hexane : AcOEt=2 : 1);
MS (EI) : m/z 376 (M⁺).

Reference Example 9



To a solution of 5-methoxy-1-tetralone (100 g) in methylene chloride (500 ml), trimethylsilylcyanide (88 ml) and zinc iodide (3 g) was added. The mixture was stirred overnight at room temperature. To the reaction solution, water was added. The mixture was extracted with mixture solvent (AcOEt : hexane=1 : 1) two times. The organic layer was washed with water and a saturated aqueous solution of sodium chloride, dried over anhydrous sodium sulfate and concentrated. The residue was dissolved in pyridine (370 ml). Phosphorous oxychloride (POCl₃) (133 ml) was added dropwise to the solution. The reaction mixture was refluxed for 3 hours and cooled to room temperature. The reaction mixture was poured into iced water and extracted with ethyl acetate two times. The organic layer was washed with water and a saturated aqueous solution of sodium chloride, dried over anhydrous sodium sulfate and concentrated. The residue was purified on silica gel column chromatography (AcOEt : CH₂Cl₂=1 : 19), and succeedingly, recrystallized from solvent of AcOEt-hexane to give the title compound (72 g) having the following physical data.

TLC : Rf 0.43 (hexane : AcOEt=3 : 1);
MS (EI) : m/z 185 (M⁺).

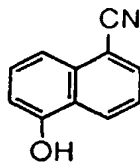
Reference Example 10

15 A mixture of compound prepared in Reference Example 9 (60 g), 2,3-dichloro-5,6-dicyano-1,4-benzoquinon (DDQ) (81 g) and benzene (700 ml) was refluxed for 6 hours. The reaction mixture was cooled to room temperature. To a reaction solution, mixture solvent (AcOEt : hexane=1 : 1) (500 ml) was added. The mixture was filtrated. The precipitate was washed with mixture solvent (AcOEt : hexane=1 : 1). The filtrate was washed with saturated aqueous solution of sodium hydrogen carbonate four times, dried over with anhydrous sodium sulfate and concentrated. The residue was recrystallized from AcOEt-hexane to give the title compound (56.6 g) having the following physical data.

20

TLC : Rf 0.42 (hexane : AcOEt=3 : 1);
 MS (EI) : m/z 183 (M⁺) ;
 m.p. 132 - 133°C.

25

Reference Example 11

40 To a solution of compound prepared in Reference Example 10 (91.6 g) in methylene chloride (500 ml), a solution of boron tribromide (104 ml) in methylene chloride (100 ml) was added dropwise at 0°C. The mixture was stirred for 20 hours at room temperature. The reaction mixture was poured into iced water and extracted with ethyl acetate two times. The organic layer was washed with aqueous solution of sodium hydrogen carbonate and a saturated aqueous solution of sodium chloride, dried over with anhydrous magnesium sulfate and concentrated to give the title compound (84.4 g) having the following physical data.

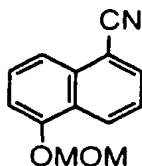
45

TLC : Rf 0.32 (hexane : AcOEt=2 : 1);
 MS (EI) : m/z 169 (M⁺) ;
 m.p. 198 - 201°C.

50

55

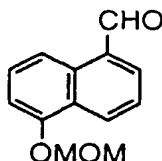
Reference Example 12



To a solution of compound prepared in Reference Example 11 (82.5 g) in methylene chloride (1000 ml), diisopropylethylamine (102 ml) and methoxymethylchloride (41 ml) were added at 0°C. The mixture was stirred overnight at room temperature. The solvent was distilled off. The residue was diluted with mixture solvent (AcOEt : hexane=1 : 1), washed with water, aqueous solution of hydrochloric acid, saturated aqueous solution of sodium hydrogen carbonate and a saturated aqueous solution of sodium chloride succeedingly, dried over with anhydrous magnesium sulfate and concentrated. The residue was recrystallized from the mixture solvent (AcOEt : hexane=1 : 10) to give the title compound (88.8 g) having the following physical data.

TLC : Rf 0.34 (hexane : AcOEt=4 : 1);
MS (EI) : m/z 213 (M⁺).

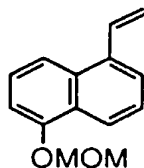
Reference Example 13



To a solution of compound prepared in Reference Example 12 (95.5 g) in toluene (750 ml), diisobutyl aluminum hydride (324 ml, 1.5 mol/toluene solution) was added at -50°C. The mixture was heated to 0°C for 2 hours. The reaction mixture was cooled to -30°C. Methanol (30 ml) was added to the mixture. The reaction solution was heated to -5°C. An aqueous solution of sodium sulfate was added to the mixture. The precipitate was filtrated. The filtrate was concentrated. The residue was dissolved in tetrahydrofuran (THF)-AcOEt (100 ml-400 ml). 2N aqueous solution of hydrochloric acid (250 ml) was added to the solution. The mixture was stirred for 30 minutes. The organic layer was isolated. The aqueous layer was extracted with ethyl acetate. The organic layer was washed with an aqueous solution of sodium hydrogen carbonate and a saturated aqueous solution of sodium chloride, dried over with anhydrous magnesium sulfate and concentrated. To the residue, hexane (600 ml) was added. The mixture was laid for 2 days. The crystal was collected by filtration to give the title compound (70.6 g) having the following physical data. In addition, the mother liquor was purified on silica gel column chromatography (hexane : AcOEt=7 : 1) to give the title compound (20.9 g) having the following physical data.

TLC : Rf 0.33 (hexane : AcOEt=3 : 1);
MS (EI) : m/z 216 (M⁺).

Reference Example 14



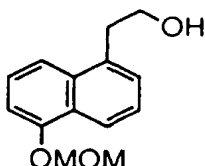
5

10

A mixture of sodium hydride (4.66 g) and dimethylsulfoxide (DMSO) (100 ml) was stirred for 50 minutes at 80°C. The reaction mixture was cooled to room temperature. A solution of methyltriphenylphosphonium bromide (41.6 g) in DMSO (120 ml) was added dropwise to the reaction mixture in order to adjust reaction temperature to 20-30°C. The mixture was stirred for 30 minutes at room temperature. To the reaction solution, a solution of compound prepared in Reference Example 13 (15.56 g) in DMSO (80 ml) was added dropwise. The mixture was stirred for 15 minutes at room temperature. The reaction mixture was poured into iced water, extracted with mixture solvent (AcOEt : hexane=1 : 2) three times. The organic layer was washed with water and a saturated aqueous solution of sodium chloride, dried over with anhydrous magnesium sulfate and concentrated. To the residue, mixture solvent (ether : hexane=1 : 4) (200 ml) was added. The mixture was filtrated. The filtrate was concentrated. The residue was purified on silica gel column chromatography (hexane : AcOEt=6 : 1) to give the title compound (14.2 g) having the following physical data.

TLC : Rf 0.52 (hexane : AcOEt=4 : 1);
MS (EI) : m/z 214 (M⁺).

Reference Example 15



30

35

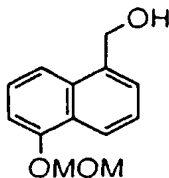
40

To a solution of compound prepared in Reference Example 14 (14.2 g) in THF (60 ml), 9-borabicyclo[3.3.1]nonane (9-BBN) (172 ml, 0.5 mol/l THF solution) was added dropwise under an atmosphere of Argon gas at room temperature. The mixture was stirred for 2.5 hours at room temperature. To the reaction solution, ethanol (30 ml) was added dropwise. In addition, to the mixture, 5N-aqueous solution of sodium hydroxide (50 ml) was added. An aqueous solution of hydrogen peroxide (50 ml) was added dropwise to the mixture in order to adjust reaction temperature to 50-60°C. The reaction mixture was stirred for 30 minutes, poured into iced water and extracted with ethyl acetate two times. The organic layer was washed with water and a saturated aqueous solution of sodium chloride, dried over with anhydrous magnesium sulfate and concentrated. The residue was purified on silica gel column chromatography (hexane : AcOEt=7 : 3) to give the title compound (14.81 g) having the following physical data.

50

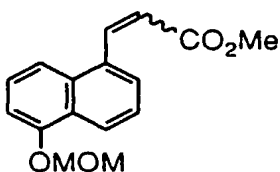
TLC : Rf 0.38 (hexane : AcOEt=7 : 3);
MS (EI) : m/z 232 (M⁺), 202.

55

Reference Example 16

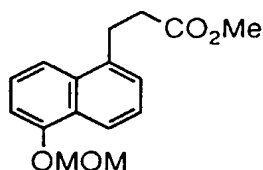
15 To a solution of compound prepared in Reference Example 13 (5.3 g) in methanol (40 ml), sodium boron hydride (910 mg) was added. The mixture was stirred for 1 hour at room temperature. The solvent was distilled off. Water was added to the residue. The mixture was extracted with ethyl acetate. The organic layer was washed with water and a saturated aqueous solution of sodium chloride, dried over with anhydrous magnesium sulfate and concentrated to give the title compound (5.21 g) having the following physical data.

20 TLC : Rf 0.33 (hexane : AcOEt=2 : 1);
MS (EI) : m/z 218 (M⁺).

Reference Example 17

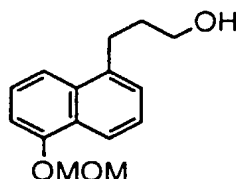
35 To a solution of compound prepared in Reference Example 13 (3.11 g) in chloroform (30 ml), carbomethoxymethylene triphenylphosphorane (98% 5.88 g) was added. The mixture was stirred for 16 hours at room temperature. The reaction mixture was concentrated. Ether was added to the residue. The precipitate was filtrated. The filtrate was concentrated. The residue was dissolved in hexane. The precipitate was filtrated. The filtrate was concentrated to give the title compound (3.92 g) having the following physical data.

40 TLC : Rf 0.50 (hexane : AcOEt=5 : 1);
MS (EI) : m/z 272 (M⁺).

Reference Example 18

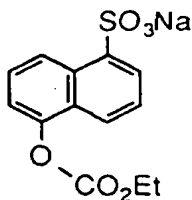
To a solution of compound prepared in Reference Example 17 (3.81 g) in ethyl acetate (70 ml), 10% Pd-C (380 mg) was added. The mixture was stirred under an atmosphere of H₂ gas for 1 hour. The reaction solution was filtrated. The filtrate was concentrated to give the title compound (3.69 g) having the following physical data.

TLC : R_f 0.48 (hexane : AcOEt=5 : 1);
MS (EI) : m/z 274 (M⁺).

Reference Example 19

To a suspension of lithium aluminum hydride (2.91 g) in THF (50 ml), a solution of compound prepared in Reference Example 18 (12.5 g) in THF (150 ml) was added dropwise at room temperature. The mixture was stirred for 1 hour at room temperature. A small amount of ethyl acetate was added to the reaction mixture. A saturated aqueous solution of anhydrous sodium sulfate was added to the mixture. The white precipitate was filtrated by Celite (Registered trade mark). The filtrate was concentrated to give the title compound (11.35 g) having the following physical data.

TLC : R_f 0.27 (hexane : AcOEt=2 : 1);
MS (EI) : m/z 246 (M⁺).

Reference Example 20

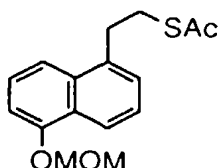
6-Hydroxy-2-naphthalene sulfonic acid sodium salt (18 g) was dissolved in 2N aqueous solution of sodium hydrox-

EP 0 845 451 A1

ide (36.6 ml) with heating. THF (70 ml) was added to the solution. Ethylchloroformate (7 ml) was added dropwise to the mixture under cooling with ice. The mixture was stirred for 3 hours at room temperature. The white crystal was filtrated, washed with water and THF and dried over under reduced pressure to give the title compound (16.3 g) having the following physical data.

TLC : Rf 0.09 (CHCl₃ : MeOH=5 : 1)
MS (EI) : m/z 318 (M⁺).

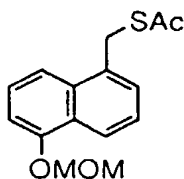
Reference Example 21



The solution of compound prepared in Reference Example 15 (7.63 g) in pyridine (20 ml) was cooled to -30 °C. Tosylchloride (8.75 g) was added to the solution. The mixture was stirred for 2 hours at room temperature. The reaction mixture was cooled to 0°C. Water (1 ml) was added to the mixture. The mixture was stirred for 20 minutes at room temperature. The reaction solution was poured into AcOEt-2N-aqueous solution of hydrochloric acid (2 : 1, 400 ml). The organic layer was isolated, washed with water and saturated aqueous solution of sodium hydrogen carbonate, dried over with anhydrous magnesium sulfate and concentrated. The residue was dissolved in acetone (100 ml). Potassium thioacetate (5.62 g) was added to solution. The mixture was refluxed for 2 hours. The reaction mixture was cooled to room temperature, poured into water and extracted with mixture solvent (AcOEt : hexane=1 : 2) two times. The organic layer was washed with water and a saturated aqueous solution of sodium chloride, dried over with anhydrous magnesium sulfate and concentrated to give the title compound (9.28 g) having the following physical data.

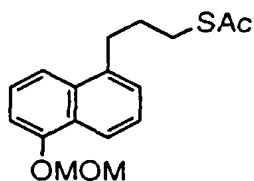
TLC : Rf 0.55 (hexane : AcOEt=7 : 3);
MS (EI) : m/z 290 (M⁺).

Reference Example 21(1)



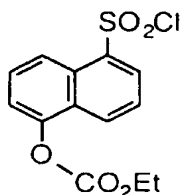
By using compound prepared in Reference Example 16, the title compound having the following physical data was obtained by the same procedure of Reference Example 21.

TLC : Rf 0.40 (hexane : AcOEt=4 : 1);
MS (EI) : m/z 276 (M⁺).

Reference Example 21(2)

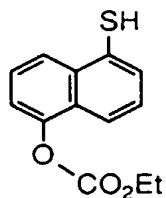
15 By using compound prepared in Reference Example 19, the title compound having the following physical data was obtained by the same procedure of Reference Example 21.

TLC : R_f 0.57 (hexane : AcOEt=7 : 3);
MS (EI) : m/z 304 (M⁺).

Reference Example 22

35 To a solution compound prepared in Reference Example 20 (16.3 g) in DMF (150 ml), thionylchloride (18.7 ml) was added dropwise for 1.5 hours at 0°C. The mixture was stirred for 2.5 hours at room temperature. The reaction mixture was poured into iced water. The white crystal was filtrated, washed with water and dried over under reduced pressure to give the title compound (13.4 g) having the following physical data.

40 TLC : R_f 0.72 (hexane : AcOEt=1 : 1);
MS (EI) : m/z 314 (M⁺).

Reference Example 23

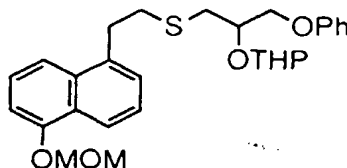
The compound prepared in Reference Example 22 (13.5 g) was dissolved in mixture solvent of water (90 ml), conc.

EP 0 845 451 A1

sulfuric acid (18 ml) and THF (100 ml). A powder of zinc (13.9 g) was added to the solution at 0°C. The mixture was stirred overnight at room temperature. The reaction solution was filtrated. The filtrate was distilled off under reduced pressure. The residual aqueous solution was extracted with ethyl acetate. The organic layer was dried over with anhydrous magnesium sulfate, and concentrated. The residue was purified on silica gel column chromatography (hexane : AcOEt=1 : 1) to give the title compound (9.4 g) having the following physical data.

TLC : Rf 0.22 (hexane : AcOEt=1 : 1);
MS (EI) : m/z 248 (M⁺).

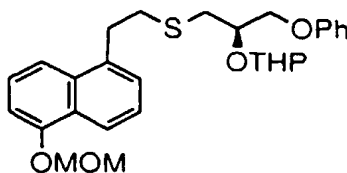
Reference Example 24



To a solution of the compound prepared in Reference Example 21 (4.5 g) and the compound prepared in Reference Example 5 (6.3 g) in ethanol (30 ml), sodium ethoxide (1.4 g) was added at 0°C. The mixture was stirred for 1 hour at room temperature. The reaction mixture was poured into iced water and extracted with ethyl acetate two times. The organic layer was washed with water and a saturated aqueous solution of sodium chloride, dried over with anhydrous magnesium sulfate and concentrated. The residue was purified on silica gel column chromatography (hexane : AcOEt=6 : 1) to give the title compound (6.75 g) having the following physical data.

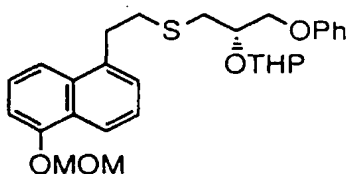
TLC : Rf 0.32 (hexane : AcOEt=5 : 1)
MS (EI) : m/z 482 (M⁺).

Reference Example 24(1)



By using the compound prepared in Reference Example 21 and the compound prepared in Reference Example 6, the title compound having the following physical data by the same procedure of Reference Example 24.

TLC : Rf 0.32 (hexane : AcOEt=5 : 1)
MS (EI) : m/z 482 (M⁺).

Reference Example 24(2)

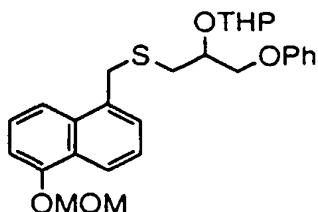
5

10

By using the compound prepared in Reference Example 21 and the compound prepared in Reference Example 6(1), the title compound having the following physical data by the same procedure of Reference Example 24.

15

TLC : Rf 0.32 (hexane : AcOEt=5 : 1)
MS (EI) : m/z 482 (M⁺).

20 Reference Example 24(3)

25

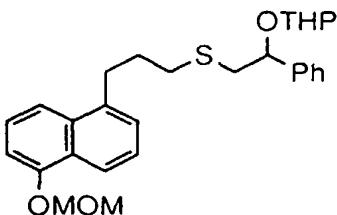
30

By using the compound prepared in Reference Example 21(1) and the compound prepared in Reference Example 5 the title compound having the following physical data by the same procedure of Reference Example 24.

35

TLC : Rf 0.32 (hexane : AcOEt=4 : 1);
MS (EI) : m/z 468 (M⁺).

40

Reference Example 25

45

50

55

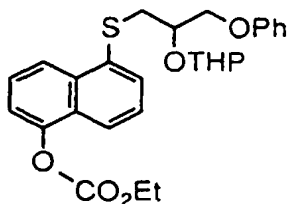
To a solution of the compound prepared in Reference Example 21(2) (61 mg) and the compound prepared in Reference Example 8 (75 mg) in ethanol (4 ml), sodium ethoxide (28 mg) was added. The mixture was stirred for 1 hour at room temperature. The reaction mixture was concentrated. Water was added to the residue. The mixture was extracted

EP 0 845 451 A1

with ethyl acetate. The organic layer was washed with water and a saturated aqueous solution of sodium chloride, dried over with anhydrous sodium sulfate and concentrated. The residue was purified on silica gel column chromatography (hexane : AcOEt=5 : 1) to give the title compound (68 mg) having the following physical data.

TLC : Rf 0.65 (hexane : AcOEt=5 : 1);
MS (EI) : m/z 466 (M⁺).

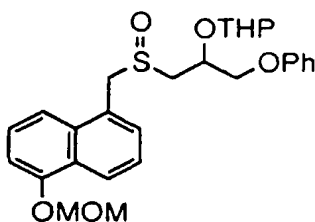
Reference Example 26



To a solution of sodium hydride (400 mg) in DMF (30 ml), the compound prepared in Reference Example 23 (2.48 g) was added under an atmosphere of Argon gas. The mixture was stirred for 30 minutes at room temperature. A solution of the compound prepared in Reference Example 5 (4.06 g) in DMF (5 ml) was added dropwise to the reaction solution at 0°C. The mixture was stirred for 6 hours at room temperature. Water (30 ml) was added to the reaction solution. The mixture was extracted with ethyl acetate. The organic layer was dried over with anhydrous magnesium sulfate and concentrated. The residue was purified on silica gel column chromatography (hexane : AcOEt=2 : 1) to give the title compound (3.44 g) having the following physical data.

TLC : Rf 0.49 (hexane : AcOEt=5 : 1);
MS (EI) : m/z 482 (M⁺).

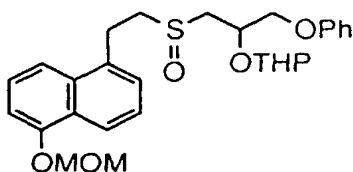
Reference Example 27



To a suspension of the compound prepared in Reference Example 24(3) (466 mg) and sodium hydrogen carbonate (170 mg) in methylene chloride (2 ml), 70% mCPBA (245 mg) was added at 0°C. The mixture was stirred for 1 hour at 0°C. Water was added to the reaction mixture. The mixture was extracted with ether. The organic layer was washed with water and a saturated aqueous solution of sodium chloride, dried over with anhydrous magnesium sulfate and concentrated. The residue was purified on silica gel column chromatography (hexane : AcOEt=1 : 4) to give the title compound (324 mg) having the following physical data.

TLC : Rf 0.12 (hexane : AcOEt=1 : 1);
MS (EI) : m/z 468 (M⁺-O).

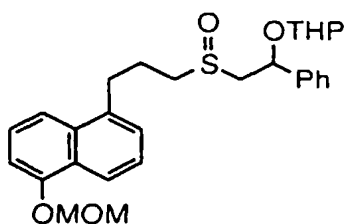
Reference Example 27(1)



By using the compound prepared in Reference Example 24, the title compound having the following physical data was obtained by the same procedure of Reference Example 27.

TLC : Rf 0.44 (hexane : AcOEt=1 : 1);
MS (EI) : m/z 498 (M⁺).

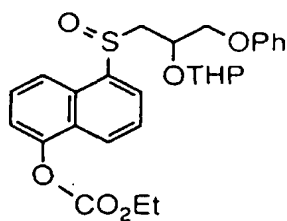
Reference Example 27(2)



By using the compound prepared in Reference Example 25, the title compound having the following physical data was obtained by the same procedure of Reference Example 27.

TLC : Rf 0.61 (AcOEt);
MS (EI) : m/z 482 (M⁺).

Reference Example 27(3)

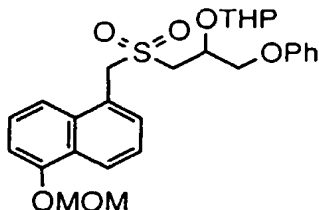


By using the compound prepared in Reference Example 26, the title compound having the following physical data was obtained by the same procedure of Reference Example 27.

EP 0 845 451 A1

TLC : Rf 0.33 (hexane : AcOEt=1 : 1);
MS (EI) : m/z 498 (M⁺).

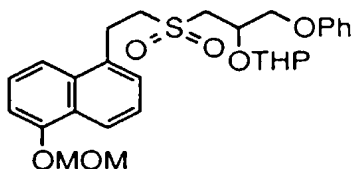
Reference Example 28



To a suspension of the compound prepared in Reference Example 24(3) (466 mg) and sodium hydrogen carbonate (340 mg) in methylene chloride (3 ml), 70% mCPBA (735 mg) was added at 0°C. The mixture was stirred for 2 hours at 0°C. Water was added to the reaction mixture. The mixture was extracted with ether. The organic layer was washed with water and a saturated aqueous solution of sodium chloride, dried over with anhydrous magnesium sulfate and concentrated. The residue was purified on silica gel column chromatography (hexane : AcOEt=2 : 1) to give the title compound (300 mg) having the following physical data.

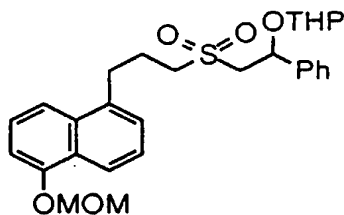
TLC : Rf 0.37 (hexane : AcOEt=1 : 1);
MS (EI) : m/z 500 (M⁺).

Reference Example 28(1)



By using the compound prepared in Reference Example 24, the title compound having the following physical data was obtained by the same procedure of Reference Example 28.

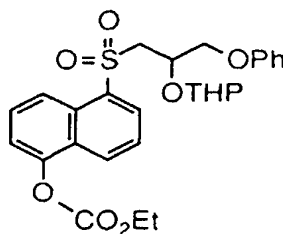
TLC : Rf 0.49 (hexane : AcOEt=1 : 1);
MS (EI) : m/z 514 (M⁺).

Reference Example 28(2)

By using the compound prepared in Reference Example 25, the title compound having the following physical data was obtained by the same procedure of Reference Example 28.

TLC : Rf 0.27 (hexane : AcOEt=5 : 1);

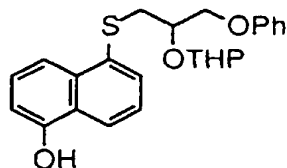
MS (EI) : m/z 498 (M⁺).

Reference Example 28(3)

By using the compound prepared in Reference Example 26, the title compound having the following physical data was obtained by the same procedure of Reference Example 28.

TLC : Rf 0.35 (hexane : AcOEt=1 : 1);

MS (EI) : m/z 514 (M⁺).

Reference Example 29

To a solution of potassium hydroxide (62 mg) in methanol (10 ml), the compound prepared in Reference Example 26 (446 mg) was added at room temperature. The mixture was stirred overnight at room temperature. 2N aqueous solu-

5

10

15

20



30

35

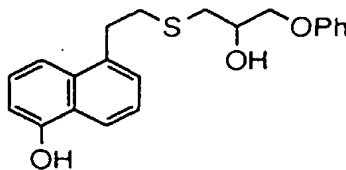


50

55

Example 1

1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-phenoxy-2RS-propanol

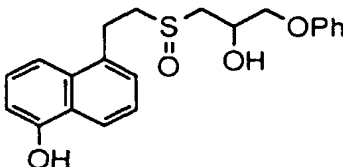


To a solution of the compound prepared in Reference Example 24 (482 mg) in mixture solvent of AcOEt-methanol (3 ml-2 ml), 4N aqueous solution of hydrochloric acid (3 ml, solution of ethyl acetate) was added. The mixture was stirred for 2 hours at room temperature. The reaction solution was concentrated. The residue was diluted with ethyl acetate, washed with water and a saturated aqueous solution of sodium chloride, dried over with anhydrous magnesium sulfate and concentrated. The residue was purified on silica gel column chromatography (hexane : AcOEt=7 : 3) to give the present invention compound (320 mg) having the following physical data.

TLC : Rf 0.42 (hexane : AcOEt=2 : 1);

MS (APCI): m/z 353 (M⁺-1), 169, 156 ;NMR (CDCl₃) : δ 8.15-8.08 (1H, m), 7.59 (1H, d, J=8.6Hz), 7.45-7.23 (5H, m), 7.02-6.80 (4H, m), 5.35 (1H, s), 4.16-3.98 (3H, m), 3.40-3.30 (2H, m), 3.01-2.68 (5H, m).**Example 1(1)**

1-[2-(5-hydroxy-1-naphthyl)ethylsulfinyl]-3-phenoxy-2RS-propanol



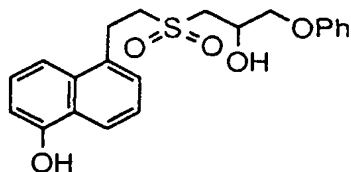
By using the compound prepared in Reference Example 27(1), the present invention compound having the following physical data was obtained by the same procedure as Example 1.

TLC : Rf 0.23 (hexane : AcOEt=1 : 1);

MS (EI) : m/z 370 (M⁺).

Example 1(2)

1-[2-(5-hydroxy-1-naphthyl)ethylsulfonyl]-3-phenoxy-2RS-propanol

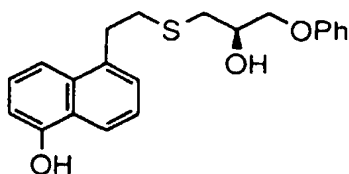


By using the compound prepared in Reference Example 28(1), the present invention compound having the following physical data was obtained by the same procedure as Example 1.

TLC : Rf 0.26 (hexane : AcOEt=1 : 1);
MS (EI) : m/z 386 (M⁺).

Example 1(3)

1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-phenoxy-2R-propanol

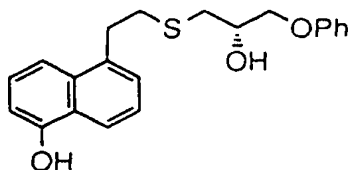


By using the compound prepared in Reference Example 24(1), the present invention compound having the following physical data was obtained by the same procedure as Example 1.

TLC : Rf 0.42 (hexane : AcOEt=2 : 1);
MS (APCI) : m/z 353 (M⁺-1), 169, 156.

Example 1(4)

1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-phenoxy-2S-propanol



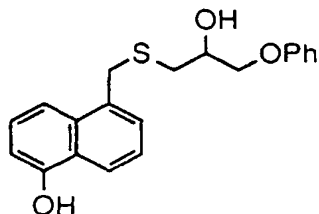
By using the compound prepared in Reference Example 24(2), the present invention compound having the following physical data was obtained by the same procedure as Example 1.

TLC : Rf 0.42 (hexane : AcOEt=2 : 1);

MS (APCI) : m/z 353 (M⁺-1), 169, 156.

Example 1(5)

1-(5-hydroxy-1-naphthyl)methylthio-3-phenoxy-2RS-propanol



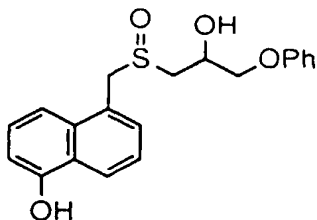
By using the compound prepared in Reference Example 24(3), the present invention compound having the following physical data was obtained by the same procedure as Example 1.

TLC : Rf 0.40 (hexane : AcOEt=1 : 1);

MS (EI) : m/z 340 (M⁺).

Example 1(6)

1-(5-hydroxy-1-naphthyl)methylsulfinyl-3-phenoxy-2RS-propanol

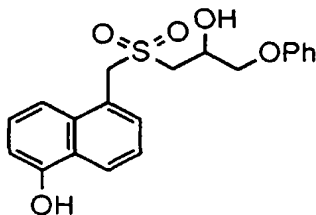


By using the compound prepared in Reference Example 27, the present invention compound having the following physical data was obtained by the same procedure as Example 1.

TLC : Rf 0.42 (AcOEt);
MS (EI) : m/z 356 (M⁺).

Example 1(7)

1-(5-hydroxy-1-naphthyl)methylsulfonyl-3-phenoxy-2RS-propanol



By using the compound prepared in Reference Example 28, the present invention compound having the following physical data was obtained by the same procedure as Example 1.

TLC : Rf 0.24 (hexane : AcOEt=1 : 1);
MS (EI) : m/z 372 (M⁺).

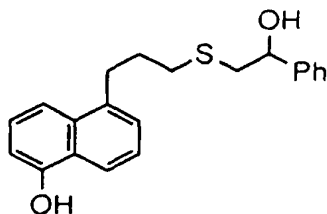
Example 1(8)

2-[3-(5-hydroxy-1-naphthyl)propylthio]-1-phenyl-1RS-ethanol

5

10

15



By using the compound prepared in Reference Example 25, the present invention compound having the following physical data was obtained by the same procedure as Example 1.

20

TLC : R_f 0.33 (hexane : AcOEt=2 : 1);
MS (EI) : m/z 338 (M⁺).

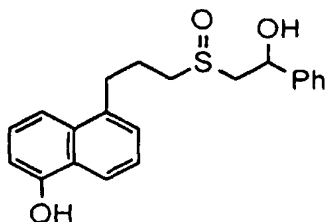
Example 1(9)

25

2-[3-(5-hydroxy-1-naphthyl)propylsulfinyl]-1-phenyl-1RS-ethanol

30

35



40

By using the compound prepared in Reference Example 27(2), the present invention compound having the following physical data was obtained by the same procedure as Example 1.

45

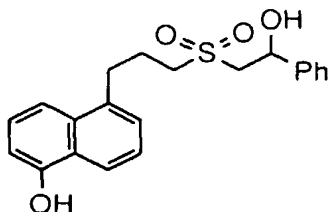
TLC : R_f 0.34 (AcOEt);
MS (EI) : m/z 354 (M⁺).

50

55

Example 1(10)

2-[3-(5-hydroxy-1-naphthyl)propylsulfonyl]-1-phenyl-1RS-ethanol

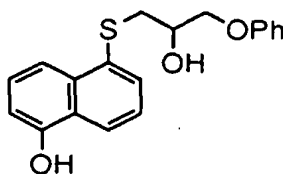


By using the compound prepared in Reference Example 28(2), the present invention compound having the following physical data was obtained by the same procedure as Example 1.

TLC : Rf 0.10 (hexane : AcOEt=2 : 1);
MS (EI) : m/z 370 (M⁺).

Example 1(11)

1-(5-hydroxy-1-naphthyl)thio-3-phenoxy-2RS-propanol

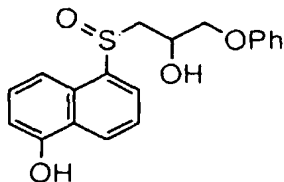


By using the compound prepared in Reference Example 29, the present invention compound having the following physical data was obtained by the same procedure as Example 1.

TLC : Rf 0.40 (hexane : AcOEt=1 : 1);
MS (EI) : m/z 326 (M⁺).

Example 1(12)

1-(5-hydroxy-1-naphthyl)sulfinyl-3-phenoxy-2RS-propanol

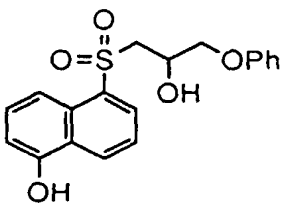


By using the compound prepared in Reference Example 29(1), the present invention compound having the following physical data was obtained by the same procedure as Example 1.

TLC : R_f 0.24 (hexane : AcOEt=1 : 1);
 MS (EI) : m/z 342 (M⁺).

Example 1(13)

1-(5-hydroxy-1-naphthyl)sulfonyl-3-phenoxy-2RS-propanol



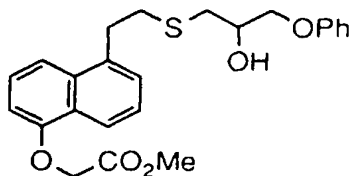
By using the compound prepared in Reference Example 29(2), the present invention compound having the following physical data was obtained by the same procedure as Example 1.

TLC : R_f 0.26 (hexane : AcOEt=1 : 1);
 MS (EI) : m/z 358 (M⁺).

EP 0 845 451 A1

Example 2

2-[5-[2-(2RS-hydroxy-3-phenoxypropylthio)ethyl]-1-naphthyloxy]acetic acid methyl ester



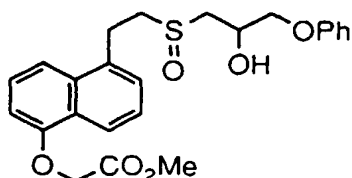
To a solution of the compound prepared in Example 1 (4.54 g) in acetone (25 ml), potassium carbonate (2.66 g) and bromoacetic acid methyl ester (1.46 ml) were added. The mixture was stirred overnight. Ethyl acetate (25 ml) was added to the reaction mixture. The mixture was filtrated. The filtrate was concentrated. The residue was purified on silica gel column chromatography (hexane : AcOEt=7 : 3) to give the present invention compound (4.95 g) having the following physical data.

TLC : Rf 0.46 (AcOEt : benzene=3 : 17);

MS (APCI) : m/z 409 ($M^+ + 1 - H_2O$).

Example 2(1)

2-[5-[2-(2RS-hydroxy-3-phenoxypropylsulfinyl)ethyl]-1-naphthyloxy]acetic acid methyl ester



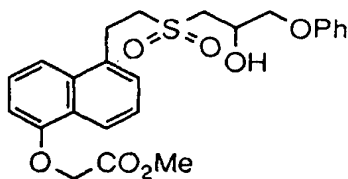
By using the compound prepared in Example 1(1), the present invention compound having the following physical data was obtained by the same procedure as Example 2.

TLC : Rf 0.36 (hexane : AcOEt=1 : 1);

MS (EI) : m/z 442 (M^+).

Example 2(2)

2-[5-[2-(2RS-hydroxy-3-phenoxypropylsulfonyl)ethyl]-1-naphthyl]oxy}acetic acid methyl ester

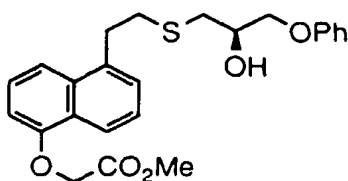


By using the compound prepared in Example 1(2), the present invention compound having the following physical data was obtained by the same procedure as Example 2.

TLC : Rf 0.40 (hexane : AcOEt=1 : 1);
MS (EI) : m/z 458 (M⁺).

Example 2(3)

2-[5-[2-(2R-hydroxy-3-phenoxypropylthio)ethyl]-1-naphthyl]oxy}acetic acid methyl ester

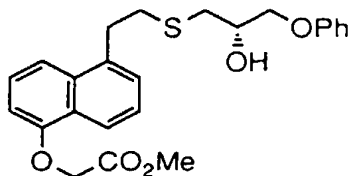


By using the compound prepared in Example 1(3), the present invention compound having the following physical data was obtained by the same procedure as Example 2.

TLC : Rf 0.46 (AcOEt : benzene=3 : 17);
MS (APCI) : m/z 409 (M⁺+1-H₂O).

Example 2(4)

2-[5-[2-(2S-hydroxy-3-phenoxypropylthio)ethyl]-1-naphthyloxy]acetic acid methyl ester

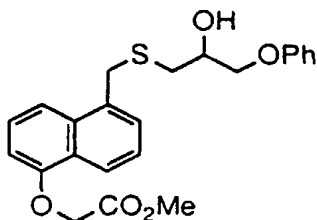


By using the compound prepared in Example 1(4), the present invention compound having the following physical data was obtained by the same procedure as Example 2.

TLC : Rf 0.46 (AcOEt : benzene=3 : 17);
 MS (APCI) : m/z 409 ($M^+ + 1 - H_2O$).

Example 2(5)

2-[5-(2RS-hydroxy-3-phenoxypropylthio)methyl-1-naphthyloxy]acetic acid methyl ester

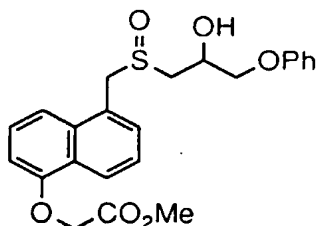


By using the compound prepared in Example 1(5), the present invention compound having the following physical data was obtained by the same procedure as Example 2.

TLC : Rf 0.30 (AcOEt : benzene=3 : 17);
 MS (EI) : m/z 412 (M^+).

Example 2(6)

2-[5-(2RS-hydroxy-3-phenoxypropylsulfinyl)methyl-1-naphthyloxy]acetic acid methyl ester

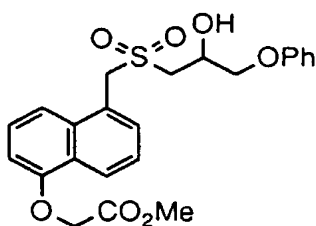


By using the compound prepared in Example 1(6), the present invention compound having the following physical data was obtained by the same procedure as Example 2.

TLC : Rf 0.22 (AcOEt);
MS (EI) : m/z 412 (M⁺-O).

Example 2(7)

2-[5-(2RS-hydroxy-3-phenoxypropylsulfonyl)methyl-1-naphthyloxy]acetic acid methyl ester

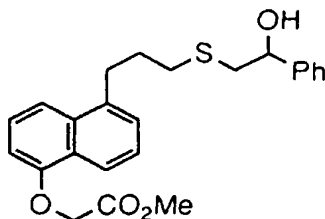


By using the compound prepared in Example 1(7), the present invention compound having the following physical data was obtained by the same procedure as Example 2.

TLC : Rf 0.18 (AcOEt : benzene=1 : 4);
MS (EI) : m/z 444 (M⁺).

Example 2(8)

2-[5-[3-(2RS-hydroxy-2-phenylethylthio)propyl]-1-naphthyloxy]acetic acid methyl ester



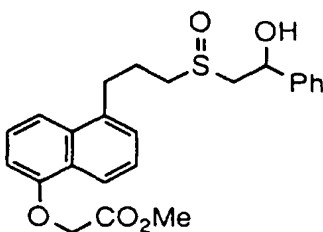
By using the compound prepared in Example 1(8), the present invention compound having the following physical data was obtained by the same procedure as Example 2.

TLC : Rf 0.35 (hexane : AcOEt=2 : 1);

MS (EI) : m/z 410 (M⁺).

Example 2(9)

2-[5-[3-(2RS-hydroxy-2-phenylethylsulfinyl)propyl]-1-naphthyloxy]acetic acid methyl ester



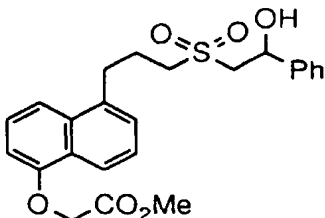
By using the compound prepared in Example 1(9), the present invention compound having the following physical data was obtained by the same procedure as Example 2.

TLC : Rf 0.36 (AcOEt);

MS (EI) : m/z 426 (M⁺).

Example 2(10)

2-[5-[3-(2RS-hydroxy-2-phenylethylsulfonyl)propyl]-1-naphthyloxy]acetic acid methyl ester

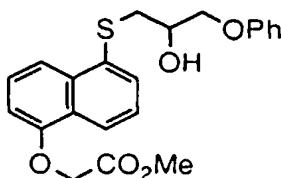


By using the compound prepared in Example 1(10), the present invention compound having the following physical data was obtained by the same procedure as Example 2.

TLC : Rf 0.10 (hexane : AcOEt=2 : 1);
MS (EI) : m/z 442 (M⁺).

Example 2(11)

2-[5-(2RS-hydroxy-3-phenoxypropylthio)-1-naphthyloxy]acetic acid methyl ester

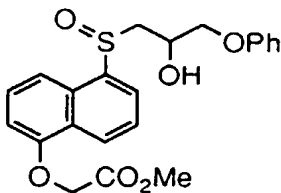


By using the compound prepared in Example 1(11), the present invention compound having the following physical data was obtained by the same procedure as Example 2.

TLC : Rf 0.42 (hexane : AcOEt=1 : 1);
MS (EI) : m/z 398 (M⁺).

Example 2(12)

2-[5-(2RS-hydroxy-3-phenoxypropylsulfinyl)-1-naphthyloxy]acetic acid methyl ester

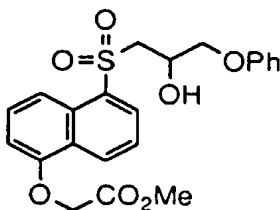


By using the compound prepared in Example 1(12), the present invention compound having the following physical data was obtained by the same procedure as Example 2.

TLC : Rf 0.29 (hexane : AcOEt=1 : 1);
MS (EI) : m/z 414 (M⁺).

Example 2(13)

2-[5-(2RS-hydroxy-3-phenoxypropylsulfonyl)-1-naphthyloxy]acetic acid methyl ester

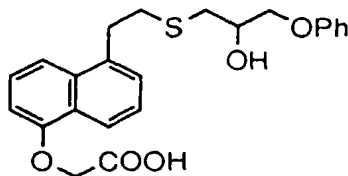


By using the compound prepared in Example 1(13), the present invention compound having the following physical data was obtained by the same procedure as Example 2.

TLC : Rf 0.31 (hexane : AcOEt=1 : 1);
MS (EI) : m/z 430 (M⁺).

Example 3

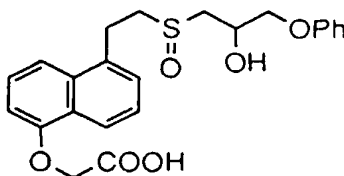
2-[5-[2-(2RS-hydroxy-3-phenoxypropylthio)ethyl]-1-naphthyl]oxy}acetic acid



To a solution of the compound prepared in Example 2 (4.80 g) in dimethoxyethane-methanol (30 ml-15 ml), 2N aqueous solution of sodium hydroxide (8 ml) was added at 0°C. The mixture was stirred for 1 hour at 0°C. 2N aqueous solution of hydrochloric acid (8.5 ml) was added to the reaction solution in order to be neutralized. The mixture was extracted with ethyl acetate. The organic layer was washed with a saturated aqueous solution of sodium chloride, dried over with anhydrous magnesium sulfate and concentrated. The residue was recrystallized from AcOEt-hexane to give the present invention compound (4.07 g) having the following physical data.

TLC : Rf 0.22 (CHCl₃ : MeOH=15 : 1);MS (EI) : m/z 412 (M⁺) ;NMR (DMSO-d₆) : δ 8.25 (1H, d, J=8Hz), 7.71 (1H, d, J=8Hz), 7.50-7.16 (5H, m), 7.02-6.69 (4H, m), 4.78 (2H, s), 4.24-4.38 (7H, m), 2.90-2.53 (2H, m).Example 3(1)

2-[5-[2-(2RS-hydroxy-3-phenoxypropylsulfinyl)ethyl]-1-naphthyl]oxy}acetic acid

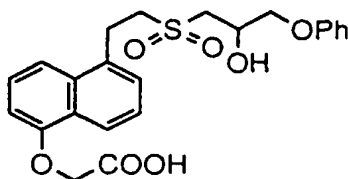


By using the compound prepared in Example 2(1), the present invention compound having the following physical data was obtained by the same procedure as Example 3.

TLC : Rf 0.26 (CHCl₃ : MeOH=15 : 1);MS (EI) : m/z 428 (M⁺) ;NMR (DMSO-d₆) : δ 8.42 (1H, d, J=8Hz), 7.73 (1H, d, J=8Hz), 7.60-7.21 (5H, m), 6.98-6.82 (4H, m), 4.81 (2H, s), 4.76-4.38 (6H, m), 4.06-3.97 (1H, m), 2.90-2.53 (2H, m).

Example 3(2)

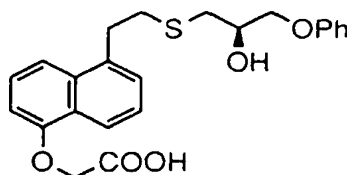
2-[5-[2-(2RS-hydroxy-3-phenoxypropylsulfonyl)ethyl]-1-naphthyloxy]acetic acid



By using the compound prepared in Example 2(2), the present invention compound having the following physical data was obtained by the same procedure as Example 3.

TLC : Rf 0.18 (CHCl₃ : MeOH=15 : 1);MS (EI) : m/z 444 (M⁺), 404, 167, 115 ;NMR (DMSO-d₆) : δ 8.22 (1H, d, J=8Hz), 7.59 (1H, d, J=8Hz), 7.42-7.14 (7H, m), 6.89-6.66 (2H, m), 4.78 (2H, s), 4.24-3.88 (7H, m), 2.90-2.53 (2H, m).Example 3(3)

2-[5-[2-(2R-hydroxy-3-phenoxypropylthio)ethyl]-1-naphthyloxy]acetic acid



By using the compound prepared in Example 2(3), the present invention compound having the following physical data was obtained by the same procedure as Example 3.

TLC : Rf 0.26 (CHCl₃ : MeOH : AcOH=19 : 1 : 0.1);MS (APCI) : m/z 411 (M⁺-1), 353 ;

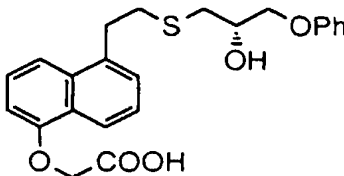
m.p. 114.0 — 115.5°C ;

NMR (DMSO-d₆) : δ 8.20-8.10 (1H, m), 7.64 (1H, d, J=8.6Hz), 7.50-7.35 (3H, m), 7.35-7.20 (2H, m), 7.00-6.85 (4H, m), 5.25 (1H, br.), 4.87 (2H, s), 3.96 (3H, m), 3.37-3.22 (2H, m), 2.98-2.65 (4H, m).

EP 0 845 451 A1

Example 3(4)

2-[5-[2-(2S-hydroxy-3-phenoxypropylthio)ethyl]-1-naphthyloxy]acetic acid



By using the compound prepared in Example 2(4), the present invention compound having the following physical data was obtained by the same procedure as Example 3.

TLC : Rf 0.26 (CHCl₃ : MeOH : AcOH=19 : 1 : 0.1);

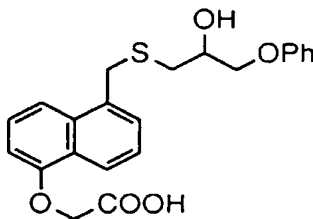
MS (APCI) : m/z 411 (M⁺-1), 353 ;

m.p. 114.0—115.5°C ;

NMR (DMSO-d₆) : δ 8.20-8.10 (1H, m), 7.64 (1H, d, J=8.6Hz), 7.50-7.35 (3H, m), 7.35-7.20 (2H, m), 7.00-6.85 (4H, m), 5.25 (1H, br.), 4.87 (2H, s), 3.96 (3H, m), 3.37-3.22 (2H, m), 2.98-2.65 (4H, m).

Example 3(5)

2-[5-(2RS-hydroxy-3-phenoxypropylthio)methyl-1-naphthyloxy]acetic acid



By using the compound prepared in Example 2(5), the present invention compound having the following physical data was obtained by the same procedure as Example 3.

TLC : Rf 0.21 (MeOH : CHCl₃=3 : 7);

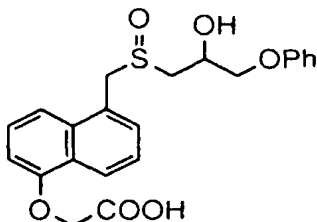
MS (EI) : m/z 398 (M⁺) ;

m.p. 105-107°C ;

NMR (DMSO-d₆+CDCl₃) : δ 8.32 (1H, d, J = 8Hz), 7.75 (1H, d, J = 8Hz), 7.58-7.14 (5H, m), 7.00-6.70 (4H, m), 4.78 (2H, s, CH₂COO), 4.60-3.80 (7H, m), 2.87-2.60 (2H, m).

Example 3(6)

2-[5-(2RS-hydroxy-3-phenoxypropylsulfinyl)methyl-1-naphthyloxy]acetic acid



By using the compound prepared in Example 2(6), the present invention compound having the following physical data was obtained by the same procedure as Example 3.

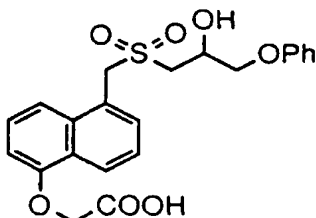
TLC : Rf 0.16 (MeOH : CHCl₃ = 3 : 7);

MS (EI) : m/z 414 (M⁺), 396 (M⁺-H₂O) ;

NMR (CD₃OD+CDCl₃) : δ 8.45 (1H, d, J = 8Hz), 7.73 (1H, d, J = 8Hz), 7.62-7.38 (3H, m), 7.34-7.19 (2H, m), 7.00-6.82 (4H, m), 5.05-4.40 (5H, m), 4.08-3.96 (2H, m), 3.44-3.05 (2H, m).

Example 3(7)

2-[5-(2RS-hydroxy-3-phenoxypropylsulfonyl)methyl-1-naphthyloxy]acetic acid



By using the compound prepared in Example 2(7), the present invention compound having the following physical data was obtained by the same procedure as Example 3.

TLC : Rf 0.17 (MeOH : CH₂Cl₂=1 : 5);

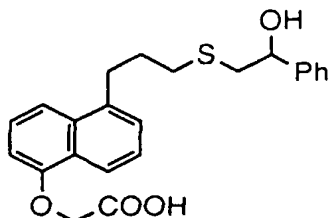
MS (EI) : m/z 430 (M⁺) ;

m.p. 186-190°C ;

NMR (CD₃OD+CDCl₃) : δ 8.48 (1H, d, J=8Hz), 7.82 (1H, d, J=8Hz), 7.70 (1H, d, J=7Hz), 7.63-7.40 (2H, m), 7.40-7.22 (2H, m), 7.10-6.77 (4H, m), 5.02 (1H, d, J=15Hz), 4.92 (1H, d, J=15Hz), 4.81 (2H, s), 4.75-4.54 (1H, m), 4.20-3.70 (2H, m), 3.40-3.33 (1H, m), 3.33-3.15 (1H, m).

Example 3(8)

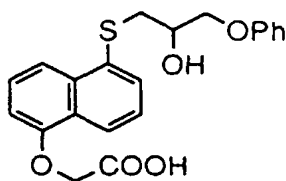
2-[5-[3-(2RS-hydroxy-2-phenylethylthio)propyl]-1-naphthyloxy]acetic acid



By using the compound prepared in Example 2(8), the present invention compound having the following physical data was obtained by the same procedure as Example 3.

TLC : Rf 0.13 (MeOH : CH₂Cl₂=1 : 5);MS (EI) : m/z 396 (M⁺), 290, 276 ;NMR (DMSO-d₆) : δ 14.00-12.40 (1H, br), 8.12 (1H, d, J=8Hz), 7.65 (1H, d, J=8Hz), 7.50-7.16 (8H, m), 6.88 (1H, d, J=7Hz), 5.47 (1H, m), 4.87 (2H, s), 4.63 (1H, m), 3.06 (2H, m), 2.75 (2H, m), 2.60-2.40 (2H, m), 1.87 (2H, m).Example 3(9)

2-[5-(2RS-hydroxy-3-phenoxypropylthio)-1-naphthyloxy]acetic acid

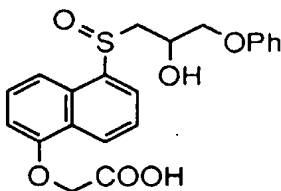


By using the compound prepared in Example 2(11), the present invention compound having the following physical data was obtained by the same procedure as Example 3.

TLC : Rf 0.25 (MeOH : CH₂Cl₂=1 : 5);MS (EI) : m/z 384 (M⁺) ;NMR (DMSO-d₆) : δ 8.68 (1H, d, J=4Hz), 8.43 (1H, d, J=8Hz), 8.40 (1H, d, J=8Hz), 7.81 (1H, t, J=4Hz), 7.66 (1H, d, J=4Hz), 7.61-7.28 (3H, m), 7.01-6.90 (3H, m), 4.92-4.79 (1H, m), 4.87 (2H, s), 4.21-3.83 (4H, m).

Example 3(10)

2-[5-(2RS-hydroxy-3-phenoxypropylsulfinyl)-1-naphthyl]oxy]acetic acid



By using the compound prepared in Example 2(12), the present invention compound having the following physical data was obtained by the same procedure as Example 3.

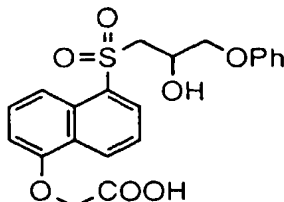
TLC : R_f 0.29 (MeOH : CH_2Cl_2 =1 : 5);

MS (EI) : m/z 401 (M^+);

NMR (DMSO- d_6) : δ 8.68 (1H, d, $J=4\text{Hz}$), 8.43 (1H, d, $J=8\text{Hz}$), 8.40 (1H, d, $J=8\text{Hz}$), 7.81 (1H, t, $J=4\text{Hz}$), 7.66 (1H, d, $J=4\text{Hz}$), 7.61-7.28 (3H, m), 7.01-6.90 (3H, m), 4.92-4.79 (1H, m), 4.87 (2H, s), 4.21-3.83 (4H, m).

Example 3(11)

2-[5-(2RS-hydroxy-3-phenoxypropylsulfonyl)-1-naphthyl]oxy]acetic acid



By using the compound prepared in Example 2(13), the present invention compound having the following physical data was obtained by the same procedure as Example 3.

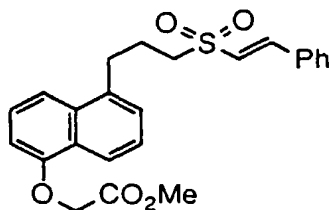
TLC : R_f 0.22 (MeOH : CH_2Cl_2 =1 : 5);

MS (EI) : m/z 416 (M^+);

NMR (DMSO- d_6) : δ 8.68 (1H, d, $J=4\text{Hz}$), 8.43 (1H, d, $J=8\text{Hz}$), 8.40 (1H, d, $J=8\text{Hz}$), 7.81 (1H, t, $J=4\text{Hz}$), 7.66 (1H, d, $J=4\text{Hz}$), 7.61-7.28 (3H, m), 7.01-6.90 (3H, m), 4.92-4.79 (1H, m), 4.87 (2H, s), 4.21-3.83 (4H, m).

Example 4

2-[5-(3-styrylsulfonylpropyl)-1-naphthyloxy]acetic acid methyl ester

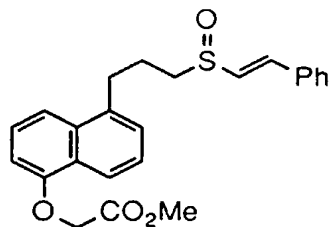


To a solution of the compound prepared in Example 2(10) (96 mg) in methylene chloride (10 ml), triethylamine (0.091 ml) and mesylchloride (37.3 ml) were added at 0°C. The mixture was heated to room temperature and stirred for 30 minutes. Water was added to the reaction mixture. The mixture was extracted with ethyl acetate. The organic layer was washed with water and a saturated aqueous solution of sodium chloride, dried over with anhydrous sodium sulfate and concentrated. The residue was purified on silica gel column chromatography (hexane : AcOEt=2 : 1) to give the present invention compound (94 mg) having the following physical data..

TLC : Rf 0.18 (hexane : AcOEt=2 : 1);
MS (EI) : m/z 424 (M⁺).

Example 4(1)

2-[5-(3-styrylsulfinylpropyl)-1-naphthyloxy]acetic acid methyl ester

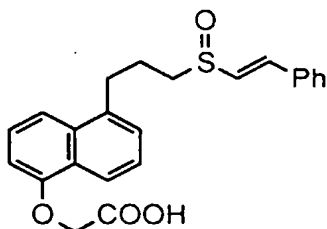


By using the compound prepared in Example 2(9), the present invention compound having the following physical data was obtained by the same procedure as Example 4.

TLC : Rf 0.50 (benzene : AcOEt=1 : 2);
MS (EI) : m/z 408 (M⁺).

Example 5

2-[5-(3-styrylsulfinylpropyl)-1-naphthyloxy]acetic acid



By using the compound prepared in Example 4(1), the present invention compound having the following physical data was obtained by the same procedure as Example 3.

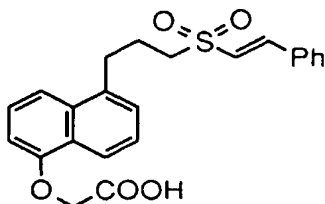
TLC : Rf 0.23 (MeOH : CH₂Cl₂=1 : 5);

MS (EI) : m/z 394 (M⁺), 378, 320, 242, 183 ;

NMR (CDCl₃-CD₃OD) : δ 8.38 (0.13H, dd, J=8, 2Hz), 8.30 (0.87H, d, J=8Hz), 7.64-7.20 (10H, m), 6.82-6.67 (1.87H, m), 6.61 (0.13H, d, J=8Hz), 4.77 (1.74H, s), 4.75 (0.26H, s), 3.30-3.03 (4H, m), 2.40-2.15 (2H, m).

Example 5(1)

2-[5-(3-styrylsulfonylpropyl)-1-naphthyloxy]acetic acid



By using the compound prepared in Example 4, the present invention compound having the following physical data was obtained by the same procedure as Example 5.

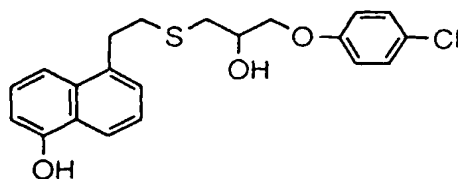
TLC : Rf 0.26 (MeOH : CH₂Cl₂=1 : 5);

MS (EI) : m/z 410 (M⁺), 378, 352, 276, 253, 242, 215 ;

NMR (CDCl₃) : δ 8.26 (1H, d, J=8Hz), 7.57 (1H, d, J=9Hz), 7.50-7.13 (9H, m), 7.13-6.40 (1H, br), 6.79 (1H, d, J=15Hz), 6.65 (1H, d, J=7Hz), 4.75 (2H, s), 3.19 (2H, t, J=8Hz), 2.90 (2H, t, J=8Hz), 2.22 (2H, m).

Example 6

1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-(4-chlorophenoxy)-2RS-propanol



By using 4-chlorophenol instead of phenol in Reference Example 2, the present invention compound having the following physical data was obtained by the same procedure as Reference Example 2 → Reference Example 3 → Reference Example 4 → Reference Example 5 → Reference Example 24 → Example 1.

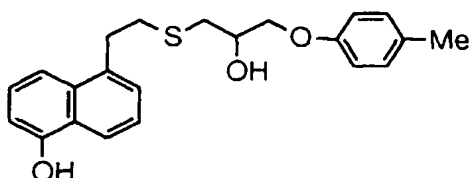
TLC : R_f 0.34 (hexane : AcOEt=2 : 1);

MS (APCI) : m/z 389, 387 (1 : 3, M-H⁺);

NMR (CDCl₃) : δ 8.12 (1H, d, J=7.4Hz), 7.58 (1H, d, J=8.4Hz), 7.38 (3H, m), 7.22 (2H, d, J=6.8Hz), 6.82 (2H, d, J=6.8Hz), 6.82 (1H, m), 5.32 (1H, s), 4.07 (1H, m), 3.96 (2H, m), 3.35 (2H, m), 2.96 (2H, m), 2.86 (1H, dd, J=14, 5Hz), 2.74 (1H, dd, J=14, 6.8Hz), 2.66 (1H, d, J=3.4Hz).

Example 6(1)

1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-(4-methylphenoxy)-2RS-propanol



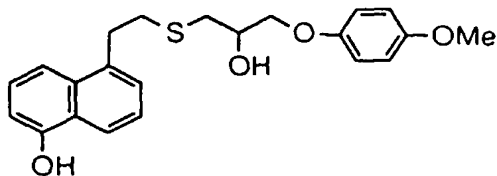
By using 4-methylphenol instead of phenol in Reference Example 2, the present invention compound having the following physical data was obtained by the same procedure as Example 6.

TLC : R_f 0.35 (hexane : AcOEt=2 : 1);

NMR (CDCl₃) : δ 8.11 (1H, d, J=8.4Hz), 7.58 (1H, d, J=8.6Hz), 7.37 (3H, m), 7.07 (2H, d, J=8Hz), 6.82 (1H, d, J=7.4Hz), 6.80 (2H, d, J=8Hz), 5.39 (1H, s), 4.08 (1H, m), 4.00 (2H, m), 3.35 (2H, m), 2.95 (2H, m), 2.91 (1H, dd, J=13.6, 5.2Hz), 2.46 (1H, dd, J=13.6, 6.8Hz), 2.70 (1H, d, J=4Hz), 2.29 (3H, s).

Example 6(2)

1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-(4-methoxyphenoxy)-2RS-propanol

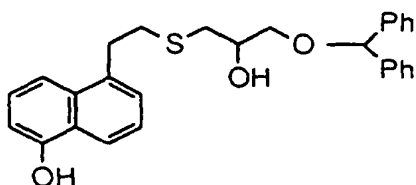


By using 4-methoxyphenol instead of phenol in Reference Example 2, the present invention compound having the following physical data was obtained by the same procedure as Example 6.

TLC : Rf 0.55 (hexane : AcOEt=2 : 1).

Example 6(3)

1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-diphenylmethoxy-2RS-propanol



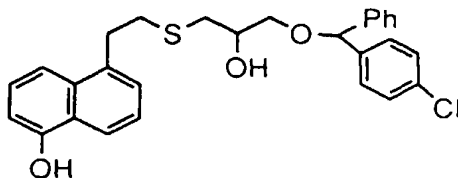
By using diphenylmethanol instead of phenol in Reference Example 2, the present invention compound having the following physical data was obtained by the same procedure as Example 6.

TLC : Rf 0.29 (hexane : AcOEt=2 : 1);

NMR (CDCl₃) : δ 8.11 (1H, m), 7.57 (1H, d, J=8.6Hz), 7.34 (13H, m), 6.81 (1H, d, J=7.4Hz), 5.43 (1H, s), 5.38 (1H, s), 3.96 (1H, m), 3.52 (2H, d, J=5.6Hz), 3.31 (2H, m), 2.91 (2H, m), 2.80 (1H, dd, J=5.3, 13.6Hz), 2.69 (1H, dd, J=7.2, 13.6Hz), 2.67 (1H, d, J=4.3Hz).

Example 6(4)

1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-[1-phenyl-1-(4-chlorophenyl)methoxy]-2RS-propanol

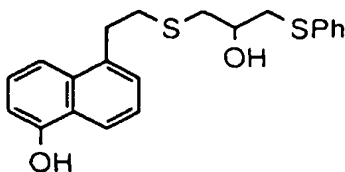


By using 1-phenyl-1-(4-chlorophenyl)methanol instead of phenol in Reference Example 2, the present invention compound having the following physical data was obtained by the same procedure as Example 6.

TLC : Rf 0.35 (hexane : AcOEt=2 : 1);
NMR (CDCl₃) : δ 8.12 (1H, d, J=9.1Hz), 7.57 (1H, d, J=8.4Hz), 7.33 (12H, m), 6.82 (1H, d, J=7.5Hz), 5.40 (1H, m), 5.35 (1H, s), 3.94 (1H, m), 3.50 (2H, d, J=4.8Hz), 3.32 (2H, m), 2.91 (2H, m), 2.73 (3H, m).

Example 6(5)

1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-phenylthio-2RS-propanol

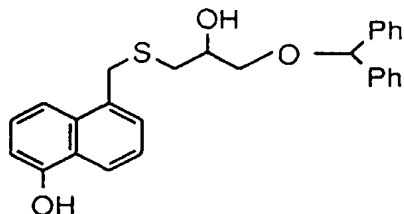


By using thiophenol instead of phenol in Reference Example 2, the present invention compound having the following physical data was obtained by the same procedure as Example 6.

TLC : Rf 0.41 (hexane : AcOEt=2 : 1).

Example 6(6)

1-(5-hydroxy-1-naphthyl)methylthio-3-diphenylmethoxy-2RS-propanol



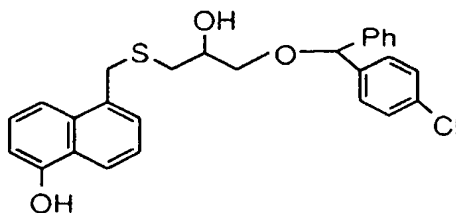
By using diphenylmethanol instead of phenol in Reference Example 2, the present invention compound having the following physical data was obtained by the same procedure as Reference Example 2 → Reference Example 3 → Reference Example 4 → Reference Example 5 → Reference Example 24(3) → Example 1.

TLC : Rf 0.17 (acetone : benzene=1 : 19);

NMR (CDCl₃) : δ 8.15 (1H, dd, J=3.0, 6.6Hz), 7.69 (1H, d, J=8.6Hz), 7.32 (13H, m), 6.82 (1H, d, J=7.3Hz), 5.50 (1H, s), 5.35 (1H, s), 4.17 (2H, s), 3.94 (1H, m), 3.48 (1H, d, J=5.2Hz), 2.55-2.77 (3H, m).

Example 6(7)

1-(5-hydroxy-1-naphthyl)methylthio-3-[1-phenyl-1-(4-chlorophenyl)methoxy]-2RS-propanol

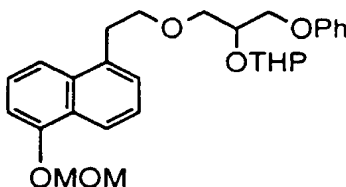


By using 1-phenyl-1-(4-chlorophenyl)methanol instead of phenol in Reference Example 2, the present invention compound having the following physical data was obtained by the same procedure as Example 6(6).

TLC : Rf 0.28 (hexane : AcOEt=2 : 1);

NMR (CDCl₃) : δ 8.16 (1H, dd, J=3.3, 6.3Hz), 7.69 (1H, d, J=9.5Hz), 7.29 (12H, m), 6.83 (1H, d, J=7.4Hz), 5.41 (1H, s), 5.30 (1H, s), 4.17 (2H, s), 3.91 (1H, m), 3.45 (2H, d, J=5.2Hz), 2.71 (1H, dd, J=5.2, 13.8Hz), 2.63 (1H, dd, J=2.3, 7.2Hz), 2.57 (1H, d, J=4.1 Hz).

Reference Example 30

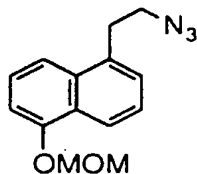


To the suspension of sodium hydride (42 mg) in DMF (1 ml), the solution of the compound prepared in Reference Example 15 (232 mg) in DMF (2 ml) was added at room temperature. To the mixture, THF (1 ml) and hexamethylphosphoramide (0.2 ml) were added at room temperature. The mixture was stirred for 30 minutes at room temperature and for 30 minutes at 40°C. To the mixture, the solution of the compound prepared in Reference Example 5 (406 mg) in DMF (2 ml) was added at room temperature. The mixture was stirred for 6 hours at 50°C. The reaction mixture was added to the aqueous solution of ammonium chloride, extracted with diethylether. The organic layer was washed with water and a saturated aqueous solution of sodium chloride, dried over with anhydrous sodium sulfate and concentrated. The residue was purified on silica gel column chromatography (hexane : AcOEt=87 : 13) to give the title compound (54.8 mg) having the following physical data.

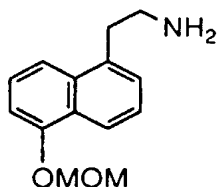
TLC : Rf 0.37 (hexane : AcOEt=3 : 1);

NMR (CDCl₃) : δ 8.18 (1H, m), 7.68 (1H, d, J=8Hz), 7.45-7.20 (5H, m), 7.09 (1H, d, J=8Hz), 7.01-6.83 (3H, m), 5.39 (2H, s), 4.88-4.72 (1H, m), 4.25-3.26 (14H, m), 1.90-1.40 (6H, m).

Reference Example 31



To the solution of the compound prepared in Reference Example 15 (5.0 g) in pyridine (15 ml), tosylchloride (6.28 g) was added at -20°C. The mixture was stirred for 2 hours at room temperature. The water (2 ml) was added dropwise to the mixture to decompose superfluous tosylchloride. To the mixture, 2N aqueous solution of hydrochloric acid (80 ml) was added. The mixture was extracted with ethyl acetate. The organic layer was washed with water and a saturated aqueous solution of sodium chloride, dried over with anhydrous sodium sulfate and concentrated to obtain crude tosyl compound. The tosyl compound was dissolved in acetone (25 ml). To the solution, sodium azide (2.8 g) and tetrabutylammonium bromide (400 mg) were added. The solution was refluxed over night. To the solution, sodium azide (2.8 g) was added. The solution was refluxed for 4 hours and cooled. The solvent was distilled off. The residue was diluted with ethyl acetate, washed with water and a saturated aqueous solution of sodium chloride, dried over with anhydrous sodium sulfate and concentrated to give the title compound (5.38 g) having the following physical data. TLC : Rf 0.52 (hexane : AcOEt=7 : 3).

Reference Example 32

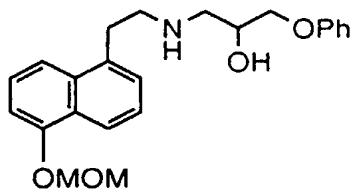
15 To the solution of the compound prepared in Reference Example 31 (1.56 g) in ethyl acetate (20 ml), 5% Pd-C (50 mg) was added. The mixture was stirred under an atmosphere of H₂ gas for 5 hours at room temperature. The solution was filtrated by Celite (Registered trade mark). The filtrate was concentrated and purified on silica gel column chromatography (MeOH : CHCl₃=3 : 97→MeOH : CHCl₃ : propylamine=10 : 90 : 1) to give the title compound (1.02 g) having the following physical data.

20

TLC : R_f 0.17 (MeOH : CHCl₃=1 : 3);

NMR (CDCl₃) : δ 8.20 (1H, m), 7.69 (1H, d, J=8Hz), 7.48-7.27 (3H, m), 7.11 (1H, d, J=8Hz), 5.40 (2H, s), 3.53 (3H, s), 3.27-3.04 (4H, m), 1.35 (2H, brs, NH₂).

25

Reference Example 33

40 The solution of the compound prepared in Reference Example 32 (300 mg) and (±)-1,2-epoxy-3-phenoxypropane (195 mg) in iso-propanol (3 ml) was stirred for 2 days at room temperature. The reaction mixture was concentrated. The residue was purified on silica gel column chromatography (MeOH : CHCl₃=3 : 97 → 1 : 9) to give the title compound (270 mg) having the following physical data.

45 TLC : R_f 0.26 (MeOH : CHCl₃=1 : 9);

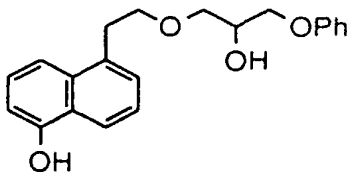
NMR (CDCl₃) : δ 8.22 (1H, m), 7.71 (1H, d, J=8Hz), 7.47-7.21 (5H, m), 7.11 (1H, d, J=8Hz), 6.99-6.84 (3H, m), 5.40 (2H, s), 4.15-3.92 (3H, m), 3.55 (3H, s), 3.20 (2H, t, J=8Hz), 3.13-2.76 (4H, m), 2.53 (2H, brs, OH & NH).

50

55

Example 7

1-[2-(5-hydroxy-1-naphthyl)ethoxy]-3-phenoxy-2RS-propanol

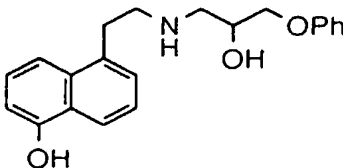


By using the compound prepared in Reference Example 30, the present invention compound having the following physical data was obtained by the same procedure as Example 1.

TLC : Rf 0.18 (hexane : AcOEt=2 : 1);
 NMR (CDCl₃) : δ 8.11 (1H, m), 7.63 (1H, d, J=8Hz), 7.46-7.21 (5H, m), 7.02-6.77 (4H, m), 5.49 (1H, s), 4.14 (1H, m), 3.96 (2H, d, J=5Hz), 3.85 (2H, t, J=7Hz), 3.63 (2H, m), 3.35 (2H, t, J=7Hz), 2.48 (1H, d, J=4Hz) .

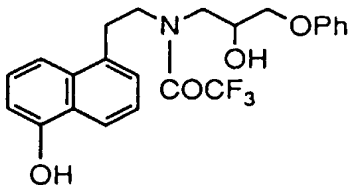
Example 7(1)

1-[2-(5-hydroxy-1-naphthyl)ethylamino]-3-phenoxy-2RS-propanol



By using the compound prepared in Reference Example 33, the present invention compound having the following physical data was obtained by the same procedure as Example 1.

TLC : Rf 0.10 (MeOH : CHCl₃=1 : 9);
 NMR (CDCl₃+DMSO = 1 : 4) : δ 8.15 (1H, m), 7.54 (1H, d, J=8Hz), 7.40-7.20 (5H, m), 7.00-6.84 (4H, m), 4.16-3.90 (3H, m), 3.80-2.50 (3H, br), 3.29 (2H, t, J=7Hz), 3.14-2.75 (4H, m).

Reference Example 34

EP 0 845 451 A1

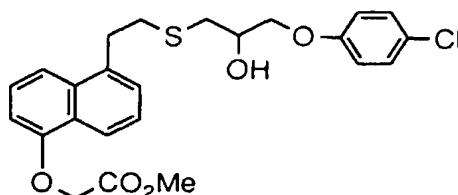
The mixture of the compound prepared in Example 7(1) (150 mg), trifluoroacetic acid ethyl ester (1 ml), triethylamine (0.5 ml) and ethanol (3 ml) was stirred for 5 hours at room temperature. The reaction mixture was concentrated and purified on silica gel column chromatography (hexane : AcOEt=5 : 2) to give the title compound (155 mg) having the following physical data.

TLC : Rf 0.53 (hexane : AcOEt=1 : 1);

NMR (CDCl₃) : rotational isomer, δ 8.21-8.10 (1H, m), 7.38 and 7.53 (combined 1H, each d, J=8Hz), 7.48-7.20 (5H, m), 7.04-6.89 (4H, m), 5.53 (1H, brs), 4.40-3.27 (9H, m), 3.10 and 2.40 (combined 1H, each m).

Example 8

2-[5-[2-(2RS-hydroxy-3-(4-chlorophenoxy)propylthio)ethyl]-1-naphthyl]oxy]acetic acid methyl ester



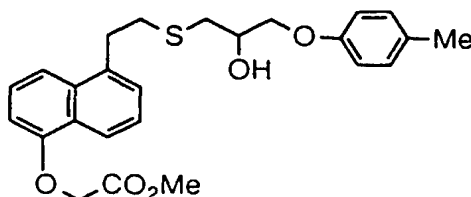
By using the compound prepared in Example 6, the present invention compound having the following physical data was obtained by the same procedure as Example 2.

TLC : Rf 0.27 (acetone : benzene=1 : 19);

NMR (CDCl₃) : δ 8.30 (1H, d, J=7.4Hz), 7.62 (1H, d, J=8.6Hz), 7.41 (3H, m), 7.22 (2H, d, J=9Hz), 6.82 (2H, d, J=9Hz), 6.72 (1H, d, J=7.4Hz), 4.83 (2H, s), 4.06 (1H, m), 3.96 (2H, m), 3.04 (3H, s), 3.35 (2H, m), 2.95 (2H, m), 2.84 (1H, dd, J=14, 5Hz), 2.73 (1H, dd, J=14, 7Hz), 2.65 (1H, d, J=4Hz).

Example 8(1)

2-[5-[2-(2RS-hydroxy-3-(4-methylphenoxy)propylthio)ethyl]-1-naphthyl]oxy]acetic acid methyl ester



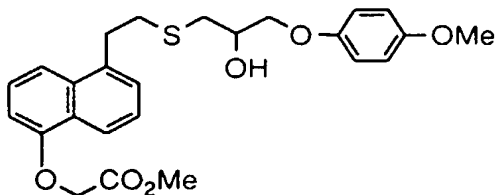
By using the compound prepared in Example 6(1), the present invention compound having the following physical data was obtained by the same procedure as Example 2.

TLC : Rf 0.37 (acetone : benzene=1 : 19);

NMR (CDCl₃) : δ 8.29 (1H, d, J=8Hz), 7.64 (1H, d, J=8.8Hz), 7.39 (3H, m), 7.07 (2H, d, J=8.8Hz), 6.80 (2H, d, J=8.8Hz), 6.72 (1H, d, J=8.8Hz), 4.82 (2H, s), 4.08 (1H, m), 3.98 (2H, m), 3.83 (3H, s), 3.45 (2H, t, J=8.6Hz), 2.94 (2H, t, J=8.6Hz), 2.88 (2H, dd, J=14, 5.2Hz), 2.75 (2H, dd, J=14, 6.8Hz), 2.68 (1H, d, J=4Hz), 2.29 (3H, s).

Example 8(2)

2-[5-[2-(2RS-hydroxy-3-(4-methoxyphenoxy)propylthio)ethyl]-1-naphthyloxy]acetic acid methyl ester

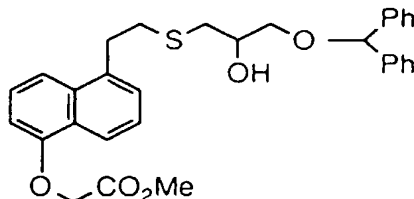


By using the compound prepared in Example 6(2), the present invention compound having the following physical data was obtained by the same procedure as Example 2.

TLC : Rf 0.41 (acetone : benzene=1 : 9);
 NMR (CDCl₃) : δ 8.30 (1H, d, J=7.8Hz), 7.63 (1H, d, J=8.6Hz), 7.41 (3H, m), 6.83 (4H, s), 6.72 (1H, d, J=8.6Hz), 4.82 (2H, s), 4.05 (1H, m), 3.96 (2H, m), 3.83 (3H, s), 3.77 (3H, s), 3.34 (2H, t, J=6.6Hz), 2.93 (2H, t, J=6.6Hz), 2.88 (1H, dd, J=14, 5Hz), 2.75 (1H, dd, J=14, 7.2Hz), 2.69 (1H, d, J=4Hz).

Example 8(3)

2-[5-[2-(2RS-hydroxy-3-diphenylmethoxypropylthio)ethyl]-1-naphthyloxy]acetic acid methyl ester

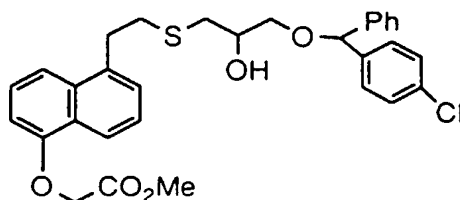


By using the compound prepared in Example 6(3), the present invention compound having the following physical data was obtained by the same procedure as Example 2.

TLC : Rf 0.33 (acetone : benzene=1 : 19);
 NMR (CDCl₃) : δ 8.29 (1H, m), 7.62 (1H, d, J=8.6Hz), 7.33 (13H, m), 6.72 (1H, d, J=7.7Hz), 5.39 (1H, s), 4.82 (2H, s), 3.95 (1H, m), 3.83 (3H, s), 3.53 (2H, d, J=5.7Hz), 2.90 (2H, m), 2.79 (1H, dd, J=5.3, 13.6Hz), 2.69 (1H, dd, J=7.2, 13.6Hz), 2.63 (1H, d, J=2.8Hz).

Example 8(4)

2-{5-[2-(2RS-hydroxy-3-(1-phenyl-1-(4-chlorophenyl)methoxy)propylthio)ethyl]-1-naphthyloxy}acetic acid methyl ester



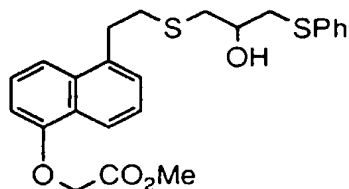
By using the compound prepared in Example 6(4), the present invention compound having the following physical data was obtained by the same procedure as Example 2.

TLC : Rf 0.26 (acetone : benzene=1 : 19);

NMR (CDCl₃) : δ 8.29 (1H, d, J=8.1 Hz), 7.62 (1H, d, J=8.5Hz), 7.33 (12H, m), 6.72 (1H, d, J=7.6Hz), 5.35 (1H, s), 4.82 (2H, s), 3.93 (1H, m), 3.83 (3H, s), 3.50 (1H, d, J=4.8Hz), 3.32 (2H, m), 2.90 (2H, m), 2.76 (2H, m), 2.60 (1H, d, J=4.3Hz).

Example 8(5)

2-{5-[2-(2RS-hydroxy-3-phenylthiopropylthio)ethyl]-1-naphthyloxy}acetic acid methyl ester

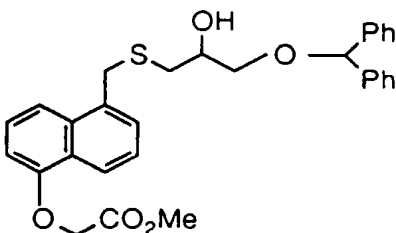


By using the compound prepared in Example 6(5), the present invention compound having the following physical data was obtained by the same procedure as Example 2.

TLC : Rf 0.33 (acetone : benzene=1 : 19).

Example 8(6)

2-[5-(2RS-hydroxy-3-diphenylmethoxypropylthio)methyl-1-naphthyloxy]acetic acid methyl ester



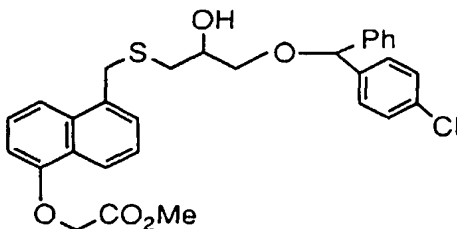
By using the compound prepared in Example 6(6), the present invention compound having the following physical data was obtained by the same procedure as Example 2.

TLC : Rf 0.33 (acetone : benzene=1 : 19);

NMR (CDCl₃) : δ 8.33 (1H, m), 7.75 (1H, d, J=8.6Hz), 7.33 (13H, m), 6.74 (1H, d, J=7.7Hz), 5.35 (1H, s), 4.82 (2H, s), 4.18 (2H, s), 3.94 (1H, m), 3.83 (3H, s), 3.48 (2H, d, J=5.2Hz), 2.71 (1H, dd, J=5.3, 13.9Hz), 2.59 (1H, dd, J=7.2, 13.9Hz), 2.58 (1H, d, J=4.1Hz).

Example 8(7)

2-[5-[2RS-hydroxy-3-(1-phenyl-1-(4-chlorophenyl)methoxy)propylthio]methyl-1-naphthyloxy]acetic acid methyl ester



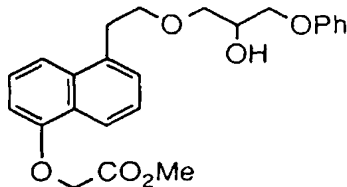
By using the compound prepared in Example 6(7), the present invention compound having the following physical data was obtained by the same procedure as Example 2.

TLC : Rf 0.29 (acetone : benzene=1 : 19);

NMR (CDCl₃) : δ 8.33 (1H, m), 7.74 (1H, d, J=8.8Hz), 7.33 (12H, m), 6.74 (1H, d, J=7.7Hz), 5.30 (1H, s), 4.82 (2H, s), 4.17 (2H, s), 3.91 (1H, m), 3.83 (3H, s), 3.44 (2H, d, J=5.2Hz), 2.70 (1H, dd, J=5.3, 13.9Hz), 2.62 (1H, dd, J=2.0, 7.2Hz), 2.54 (1H, d, J=3.8Hz).

Example 8(8)

2-[5-[2-(2RS-hydroxy-3-phenoxypropoxy)ethyl]-1-naphthyloxy]acetic acid methyl ester



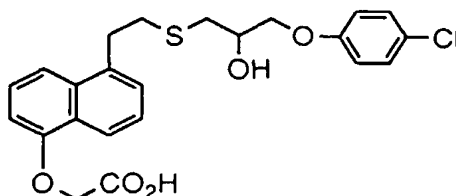
By using the compound prepared in Example 7, the present invention compound having the following physical data was obtained by the same procedure as Example 2.

TLC : Rf 0.37 (AcOEt : CH₂Cl₂=1 : 9);

NMR (CDCl₃) : δ 8.29 (1H, m), 7.69 (1H, d, J=8Hz), 7.47-7.20 (5H, m), 7.01-6.82 (3H, m), 6.71 (1H, d, J=8Hz), 4.82 (2H, s), 4.12 (1H, m), 3.95 (2H, d, J=5.5Hz), 3.96-3.77 (5H, m), 3.62 (2H, m), 3.35 (2H, t, J=7Hz), 2.44 (1H, d, J=3Hz).

Example 9

2-[5-[2-(2RS-hydroxy-3-(4-chlorophenoxy)propylthio)ethyl]-1-naphthyloxy]acetic acid



By using the compound prepared in Example 8, the present invention compound having the following physical data was obtained by the same procedure as Example 3.

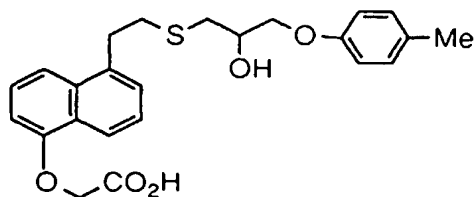
TLC : Rf 0.61 (MeOH : CHCl₃ : AcOH=1 : 18 : 1);

MS (APCI) : m/z 445, 447 (3:1), (M-H)⁺;

NMR (DMSO-d₆) : δ 13.08 (1H, brs), 8.15 (1H, t, J=4.4Hz), 7.63 (1H, d, J=8.8Hz), 7.43 (3H, m), 7.31 (2H, d, J=8.8Hz), 6.95 (2H, d, J=8.8Hz), 6.89 (1H, d, J=8.8Hz), 5.29 (1H, m), 4.87 (2H, s), 3.95 (3H, m), 3.30 (2H, m), 2.90 (2H, t, J=7Hz), 2.80 (1H, dd, J=14, 4Hz), 2.70 (1H, dd, J=14, 6Hz).

Example 9(1)

2-[5-[2-(2RS-hydroxy-3-(4-methylphenoxy)propylthio)ethyl]-1-naphthoxy]acetic acid



By using the compound prepared in Example 8(1), the present invention compound having the following physical data was obtained by the same procedure as Example 3.

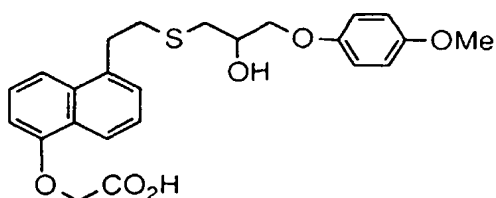
TLC : Rf 0.60 (MeOH : CHCl₃ : AcOH=1 : 18 : 1);

MS (APCI) : m/z 425 (M-H)+;

NMR (DMSO-d₆) : δ 13.07 (1H, brs), 8.14 (1H, t, J=4.2Hz), 7.63 (1H, d, J=8.6Hz), 7.43 (3H, m), 7.07 (2H, d, J=8.2Hz), 6.89 (1H, d, J=8.6Hz), 6.72 (2H, d, J=8.2Hz), 5.23 (1H, d, J=5Hz), 4.87 (2H, s), 3.95 (3H, m), 3.30 (2H, m), 2.90 (2H, t, J=8Hz), 2.82 (1H, dd, J=14, 6Hz), 2.70 (1H, dd, J=14, 6Hz), 2.22 (3H, s).

Example 9(2)

2-[5-[2-(2RS-hydroxy-3-(4-methoxyphenoxy)propylthio)ethyl]-1-naphthoxy]acetic acid



By using the compound prepared in Example 8(2), the present invention compound having the following physical data was obtained by the same procedure as Example 3.

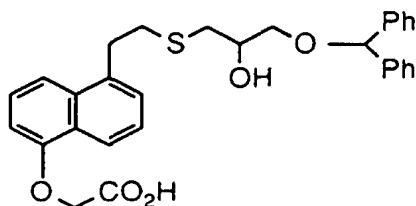
TLC : Rf 0.56 (MeOH : CHCl₃ : AcOH=1 : 18 : 1);

MS (APCI) : m/z 441 (M-H)+;

NMR (DMSO-d₆) : δ 13.07 (1H, brs), 8.14 (1H, t, J=6Hz), 7.63 (1H, d, J=8.4Hz), 7.43 (3H, m), 6.89 (1H, d, J=6Hz), 6.85 (4H, s), 5.22 (1H, d, J=4.4Hz), 4.88 (2H, s), 3.90 (3H, m), 3.69 (3H, s), 3.25 (2H, m), 2.88 (2H, t, J=9Hz), 2.82 (1H, dd, J=13, 4Hz), 2.68 (1H, dd, J=13, 6Hz).

Example 9(3)

2-[5-[2-(2RS-hydroxy-3-diphenylmethoxypropylthio)ethyl]-1-naphthyl]oxy}acetic acid



By using the compound prepared in Example 8(3), the present invention compound having the following physical data was obtained by the same procedure as Example 3.

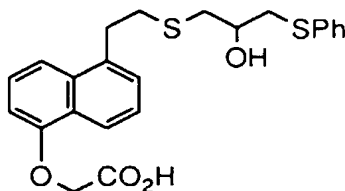
TLC : Rf 0.60 (MeOH : CHCl₃ : AcOH=10 : 100 :1);

MS (FAB) : m/z 503 (M+1)⁺, 229, 207;

NMR (CDCl₃) : δ 8.25 (1H, d, J=8.0Hz), 7.63 (1H, d, J=8.4Hz), 7.33 (13H, m), 6.74 (1H, d, J=7.7Hz), 5.38 (1H, s), 4.84 (2H, s), 3.94 (1H, m), 3.51 (2H, d, J=4.8Hz), 3.31 (2H, m), 2.89 (2H, m), 2.78 (1H, dd, J=5.6, 13.8Hz), 2.66 (1H, dd, J=7.2, 13.8Hz).

Example 9(4)

2-[5-[2-(2RS-hydroxy-3-phenylthiopropylthio)ethyl]-1-naphthyl]oxy}acetic acid



By using the compound prepared in Example 8(5), the present invention compound having the following physical data was obtained by the same procedure as Example 3.

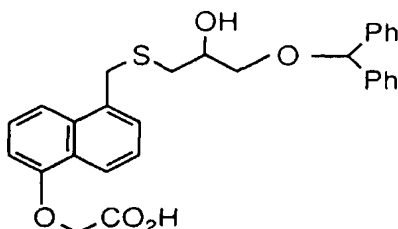
TLC : Rf 0.56 (MeOH : CHCl₃ : AcOH=1 : 18 : 1);

MS (APCI) : m/z 427 (M-H)⁺;

NMR (DMSO-d₆) : δ 13.09 (1H, brs), 8.14 (1H, dd, J=7, 3.2Hz), 7.62 (1H, d, J=8.6Hz), 7.50-7.22 (7H, m), 7.22-7.10 (1H, m), 6.89 (1H, d, J=7.2Hz), 5.31 (1H, d, J=4.8Hz), 4.87 (2H, s), 3.78 (1H, m), 3.25 (2H, t, J=8Hz), 3.16 (1H, dd, J=13, 5Hz), 3.03 (1H, dd, J=13, 6Hz), 2.85 (2H, t, J=8Hz), 2.80 (1H, dd, J=13, 5Hz), 2.69 (1H, dd, J=13, 6Hz).

Example 9(5)

2-[5-(2RS-hydroxy-3-diphenylmethoxypropylthio)methyl-1-naphthyloxy]acetic acid



By using the compound prepared in Example 8(6), the present invention compound having the following physical data was obtained by the same procedure as Example 3.

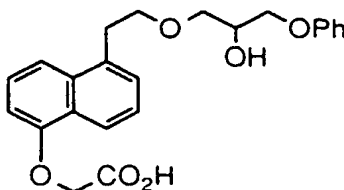
TLC : Rf 0.55 (MeOH : CHCl₃ : AcOH=10 : 100 :1);

MS (FAB) : m/z 489 (M+1)⁺, 338;

NMR (CDCl₃) : δ 8.30 (1H, m), 7.77 (1H, d, J=8.5Hz), 7.35 (13H, m), 6.76 (1H, d, J=7.9Hz), 5.34 (1H, s), 4.85 (2H, s), 4.16 (2H, s), 3.94 (1H, m), 3.47 (2H, d, J=5.1 Hz), 2.71 (1H, dd, J=5.2, 13.8Hz), 2.59 (1H, dd, J=7.2, 13.8Hz).

Example 9(6)

2-[5-[2-(2RS-hydroxy-3-phenoxypropoxy)ethyl]-1-naphthyloxy]acetic acid



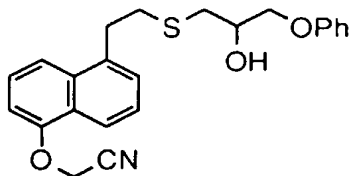
By using the compound prepared in Example 8(8), the present invention compound having the following physical data was obtained by the same procedure as Example 3.

TLC : Rf 0.17 (MeOH : CHCl₃=1 : 3);

NMR (DMSO-d₆) : δ 13.00 (1H, brs), 8.13 (1H, dd, J=8, 2Hz), 7.66 (1H, d, J=9Hz), 7.50-7.20 (5H, m), 6.98-6.82 (4H, m), 5.07 (1H, m), 4.87 (2H, s), 4.00-3.10 (9H, m).

Example 10

1-cyanomethoxy-5-[2-(2RS-hydroxy-3-phenoxypropylthio)ethyl]naphthalene

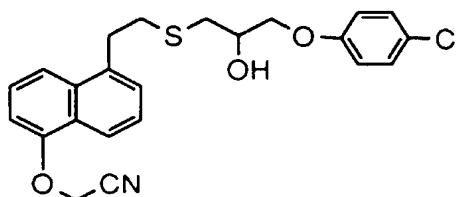


By using bromoacetonitrile instead of bromoacetic acid methyl ester in Example 2 and the compound prepared in Example 1, the present invention compound having the following physical data was obtained by the same procedure as Example 2.

TLC : Rf 0.33 (benzene : AcOEt=17 : 3);

NMR (CDCl₃) : δ 8.17 (1H, m), 7.73 (1H, d, J=8Hz), 7.52-7.23 (5 H, m), 7.05-6.85 (4H, m), 4.95 (2H, s, -OCH₂), 4.20-3.96 (3H, m), 3.38 (2H, t, J=7Hz), 3.03-2.60 (5H, m).Example 10(1)

1-cyanomethoxy-5-[2-[2RS-hydroxy-3-(4-chlorophenoxy)propylthio]ethyl]naphthalene



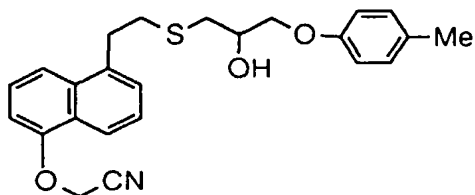
By using the compound prepared in Example 6, the present invention compound having the following physical data was obtained by the same procedure as Example 10.

TLC : Rf 0.45 (acetone : benzene=1 : 9);

MS (EI) : m/z 427, 429 (3:1) (M)⁺, 387, 389 (3:1) (M-40)⁺;NMR (CDCl₃) : δ 8.14 (1H, d, J=7.6Hz), 7.72 (1H, d, J=8.6Hz), 7.43 (3H, m), 7.24 (2H, d, J=9.2Hz), 6.93 (1H, d, J=7.6Hz), 6.82 (2H, d, J=9.2Hz), 4.97 (2H, s), 4.06 (1H, m), 3.97 (2H, m), 3.36 (2H, t, J=7Hz), 2.95 (2H, t, J=7Hz), 2.89 (1H, dd, J=13, 5.2Hz), 2.75 (1H, dd, J=13, 7Hz), 2.66 (1H, d, J=4.2Hz).

Example 10(2)

1-cyanomethoxy-5-[2-[2RS-hydroxy-3-(4-methylphenoxy)propylthio]ethyl]naphthalene



By using the compound prepared in Example 6(1), the present invention compound having the following physical data was obtained by the same procedure as Example 10.

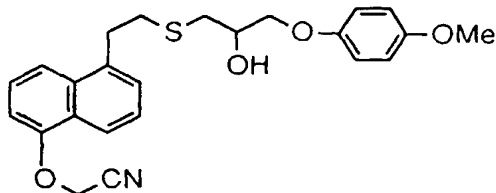
TLC : Rf 0.45 (acetone : benzene=1 : 9);

MS (EI) : m/z 407 (M)⁺, 367 (M-40)⁺;

NMR (DMSO-d₆) : δ 8.14 (1H, t, J=7.6Hz), 7.73 (1H, d, J=8.8Hz), 7.43 (3H, m), 7.08 (2H, d, J=8.8Hz), 6.94 (1H, d, J=7.6Hz), 6.80 (2H, d, J=8.2Hz), 4.96 (2H, s), 4.08 (1H, m), 3.97 (2H, m), 3.37 (2H, t, J=7Hz), 2.95 (2H, t, J=7Hz), 2.90 (1H, dd, J=14, 5.2Hz), 2.75 (1H, dd, J=14, 6.8Hz), 2.68 (1H, d, J=4.2Hz), 2.29 (3H, s).

Example 10(3)

1-cyanomethoxy-5-[2-[2RS-hydroxy-3-(4-methoxyphenoxy)propylthio]ethyl]naphthalene



By using the compound prepared in Example 6(2), the present invention compound having the following physical data was obtained by the same procedure as Example 10.

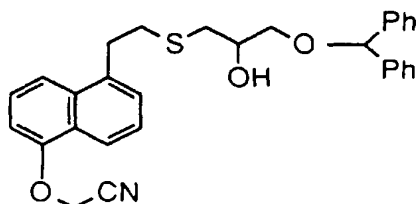
TLC : Rf 0.38 (acetone : benzene=1 : 9);

MS (EI) : m/z 423 (M)⁺;

NMR (DMSO-d₆) : δ 8.16 (1H, t, J=7.5Hz), 7.73 (1H, d, J=8.6Hz), 7.46 (3H, m), 6.94 (1H, d, J=7Hz), 6.83 (4H, s), 4.97 (2H, s), 4.06 (1H, m), 3.97 (2H, m), 3.77 (3H, s), 3.37 (2H, t, J=7.4Hz), 2.95 (2H, t, J=7.4Hz), 2.89 (1H, dd, J=14, 6.4Hz), 2.76 (1H, dd, J=13, 6.8Hz), 2.68 (1H, d, J=4Hz).

Example 10(4)

1-cyanomethoxy-5-[2-(2RS-hydroxy-3-diphenylmethoxypropylthio)ethyl]naphthalene

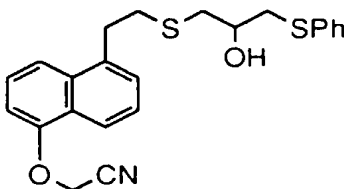


By using the compound prepared in Example 6(3), the present invention compound having the following physical data was obtained by the same procedure as Example 10.

TLC : Rf 0.32 (acetone : benzene=1 : 19);
 MS (FAB) : m/z 484 (M+1)+, 443, 391, 168;
 NMR (CDCl₃) : δ 8.13 (1H, d, J=9.2Hz), 7.72 (1H, d, J=8.7Hz), 7.34 (13H, m), 6.93 (1H, d, J=7.7Hz), 5.39 (1H, s),
 4.95 (1H, s), 3.95 (1H, m), 3.52 (1H, d, J=5.7Hz), 3.33 (2H, dd, J=7.3, 9.7Hz), 2.90 (2H, m), 2.83 (1H, dd, J=5.3,
 13.7Hz), 2.68 (1H, dd, J=7.2, 13.7Hz), 2.63 (1H, d, J=4.2Hz).

Example 10(5)

1-cyanomethoxy-5-[2-(2RS-hydroxy-3-phenylthiopropylthio)ethyl]naphthalene

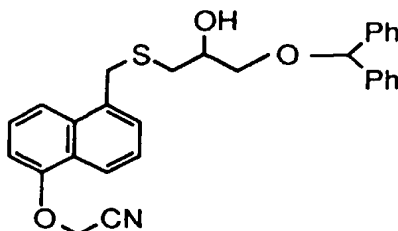


By using the compound prepared in Example 6(5), the present invention compound having the following physical data was obtained by the same procedure as Example 10.

TLC : Rf 0.33 (acetone : benzene=1 : 19);
 MS (EI) : m/z 409 (M)+;
 NMR (CDCl₃) : δ 8.13 (1H, d, J=7.8Hz), 7.70 (1H, d, J=8.8Hz), 7.47 (1H, d, J=7.2Hz), 7.42-7.34 (4H, m), 7.34-7.10
 (3H, m), 4.97 (2H, s), 3.82 (1H, m), 3.33 (2H, t, J=7Hz), 3.15 (1H, dd, J=13.8, 5.2Hz), 3.03 (1H, dd, J=13.8, 6.6Hz),
 2.89 (2H, t, J=7Hz), 2.84 (1H, dd, J=13.8, 4.6Hz), 2.68 (1H, dd, J=13.8, 7.4Hz).

Example 10(6)

1-cyanomethoxy-5-[(2RS-hydroxy-3-diphenylmethoxy)propylthiomethyl]naphthalene



By using the compound prepared in Example 6(6), the present invention compound having the following physical data was obtained by the same procedure as Example 10.

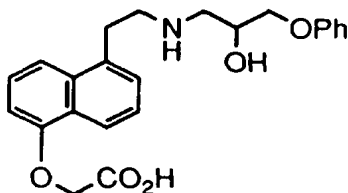
TLC : Rf 0.30 (acetone : benzene=1 : 19);

MS (FAB) : m/z 302 (M-C13H11)+, 196, 168;

NMR (CDCl₃) : δ 8.17 (1H, dd, J=2.9, 6.6Hz), 7.85 (1H, d, J=8.7Hz), 7.36 (13H, m), 6.95 (1H, d, J=7.7Hz), 5.35 (1H, s), 4.96 (2H, s), 4.18 (2H, s), 3.94 (1H, m), 3.49 (2H, d, J=5.3Hz), 2.71 (1H, dd, J=5.2, 13.7Hz), 2.59 (1H, dd, J=7.2, 13.7Hz), 2.56 (1H, d, J=7.3Hz).

Example 11

2-[5-[2-(2RS-hydroxy-3-phenoxypropylamino)ethyl]-1-naphthyloxy]acetic acid



By using the compound prepared in Reference Example 34, the present invention compound having the following physical data was obtained by the same procedure as Example 2 \rightarrow Example 3.

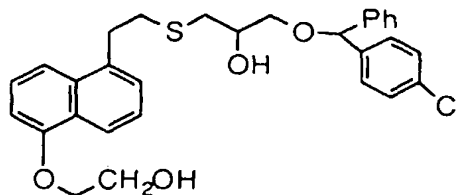
TLC : Rf 0.37 (MeOH : CHCl₃ : AcOH=2 : 6 : 1);

MS (FAB) : m/z 396 ((M+H)+);

NMR (DMSO-d₆) : δ 8.18 (1H, d, J=8Hz), 7.40-7.20 (4H, m), 7.14-7.07 (4H, m), 6.72-6.60 (2H, m), 4.58 (2H, s), 4.37-2.90 (12H, m).

Example 12

2-{5-[2-(2RS-hydroxy-3-(1-phenyl-1-(4-chlorophenyl)methoxy)propylthio)ethyl]-1-naphthyloxy}ethanol

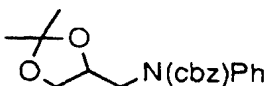


By using 2-bromo ethanol instead of bromoacetic acid methyl ester in Example 2 and the compound prepared in Example 6(4), the present invention compound having the following physical data was obtained by the same procedure as Example 2.

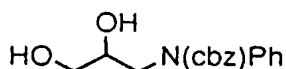
TLC : Rf 0.19 (hexane : AcOEt=2 : 1);

MS (APCI) : m/z 523 (M+1)+, 305, 215, 201;

NMR (DMSO-d6) : δ 8.20 (1H, dd, J=2.1, 7.6Hz), 7.59 (1H, d, J=8.7Hz), 7.32 (12H, m), 6.84 (1H, d, J=7.8Hz), 5.34 (1H, s), 4.27 (2H, m), 4.11 (2H, m), 3.92 (1H, m), 3.49 (2H, d, J=5.4Hz), 3.32 (2H, dd, J=7.1, 9.6Hz), 2.90 (2H, m), 2.78 (1H, dd, J=5.3, 11.7Hz), 2.70 (1H, dd, J=2.3, 7.1 Hz), 2.61 (1H, d, J=2.5Hz), 2.08 (1H, m).

Reference Example 35

To the solution of benzyloxycarbonylaniline (2.32 g) in anhydrous DMF (30 ml), sodium hydride (426 mg) was added under an atmosphere of argon gas at 0°C. The mixture was stirred for 30 minutes at room temperature. To the mixture, the compound prepared in Reference Example 1 (2.65 g) was added. The mixture was stirred for 1 hour at 80°C. To the reaction mixture, water was added to decompose the superfluous sodium hydride. The mixture was extracted with ethyl acetate, washed with water and a saturated aqueous solution of sodium chloride, dried over with anhydrous magnesium sulfate and concentrated under the reduced pressure. The residue was purified on silica gel column chromatography (hexane : AcOEt=6 : 1) to give the title compound (2.52 g) having the following physical data. TLC : Rf 0.36 (hexane : AcOEt=4 : 1).

Reference Example 36

The solution of the compound prepared in Reference Example 35 (2.52 g) in aqueous 80% acetic acid solution (25

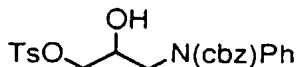
EP 0 845 451 A1

ml) was stirred for 10 hours at room temperature. The reaction mixture was concentrated under the reduced pressure. The residue was purified on silica gel column chromatography (CHCl_3 : MeOH =30 : 1) to give the title compound (1.69 g) having the following physical data.

5 TLC : Rf 0.09 (hexane : AcOEt =1 : 1).

Reference Example 37

10



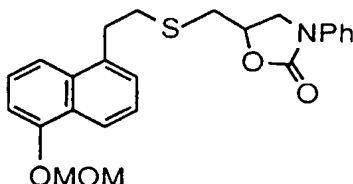
15

To the solution of the compound prepared in Reference Example 36 (328 mg) in pyridine (2.5 ml), tosylchloride (217 mg) was added under an atmosphere of argon gas at -20°C . The mixture was stirred for 3.5 hours at room temperature. To the reaction mixture, a small amount of water was added. The mixture was stirred for 10 minutes, extracted with ethyl acetate, washed with 1N aqueous solution of hydrochloric acid, water and a saturated aqueous solution of sodium chloride successively, dried over with anhydrous magnesium sulfate and concentrated under the reduced pressure to give the title compound (522 mg) having the following physical data. This residue was used in the next reaction without purification.

25 TLC : Rf 0.55 (hexane : AcOEt =1 : 1).

Reference Example 38

30



35

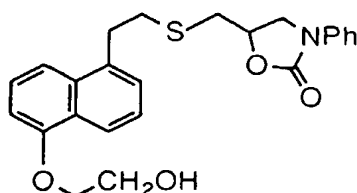
40

To the ethanol (3.0 ml), sodium hydride (56 mg) was added under an atmosphere of argon gas at 0°C . The mixture was stirred for 10 minutes. To the mixture, the compound prepared in Reference Example 21 (310 mg) and the compound prepared in Reference Example 37 (522 mg) in ethanol (3.0 ml) was added dropwise. The mixture was stirred for 2 hours at room temperature. To the reaction mixture, a saturated aqueous solution of ammonium chloride was added to decompose the superfluous reagent. The reaction mixture was extracted with ethyl acetate, washed with water and a saturated aqueous solution of sodium chloride, dried over with anhydrous magnesium sulfate and concentrated under the reduced pressure. The residue was purified on silica gel column chromatography (hexane : AcOEt =3 : 1) to give the title compound (427 mg) having the following physical data.

50 TLC : Rf 0.36 (hexane : AcOEt =2 : 1).

55

Reference Example 39



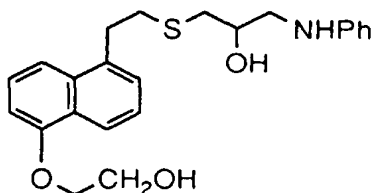
By using the compound prepared in Reference Example 38, the title compound having the following physical data was obtained by the same procedure as Example 1 → Example 12.

TLC : Rf 0.20 (hexane : AcOEt=1 : 1);

NMR (CDCl₃) : δ 8.21 (1H, m), 7.60 (1H, d, J=8.6Hz), 7.33-7.55 (7H, m), 7.18 (1H, m), 6.85 (1H, d, J=7.6Hz), 6.69 (1H, m), 4.27 (2H, m), 3.99-4.14 (3H, m), 3.80 (1H, dd, J=6.6, 9.2Hz), 3.35 (2H, m), 2.91-3.06 (3H, m), 2.78 (1H, dd, J=7.4, 13.8Hz), 2.11 (1H, t, J=6.4Hz).

Example 13

2-[5-[2-(2RS-hydroxy-3-phenylaminopropylthio)ethyl]-1-naphthoxy]ethanol



To the solution of the compound prepared in Reference Example 39 (138 mg) in methanol (10 ml), aqueous 40% sodium hydroxide solution (0.5 ml) was added at room temperature. The solution was stirred for 7 days. The mixture was concentrated to the volume of about 3.0 ml, extracted with ethyl acetate, washed with water and a saturated aqueous solution of sodium chloride, dried over with anhydrous magnesium sulfate and concentrated under the reduced pressure. The residue was purified on silica gel column chromatography (CHCl₃ : MeOH=50 : 1) to give the present invention compound (116 mg) having the following physical data.

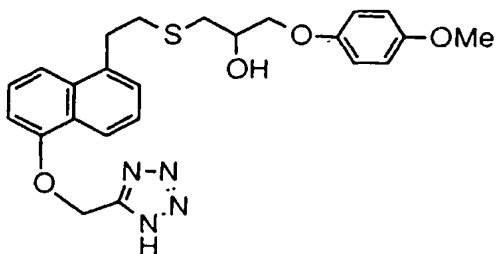
TLC : Rf 0.62 (MeOH : CHCl₃=1 : 10);

MS (APCI) : m/z 398 (M+1)⁺, 380, 245, 215;

NMR (CDCl₃) : δ 8.21 (1H, dd, J=2.2, 7.6Hz), 7.59 (1H, d, J=8.6Hz), 7.34-7.48 (3H, m), 7.12-7.24 (2H, m), 6.85 (1H, d, J=7.6Hz), 6.73 (1H, t, J=7.2Hz), 6.63 (2H, d, J=7.6Hz), 4.27 (2H, t, J=4.2Hz), 3.82-4.18 (4H, m), 3.25-3.38 (3H, m), 3.06 (1H, dd, J=7.4, 13.0Hz), 2.95 (1H, d, J=8.4Hz), 2.92 (1H, d, J=9.2Hz), 2.77 (1H, dd, J=4.4, 13.8Hz), 2.57-2.68 (2H, m), 2.10 (1H, m).

Example 14

1-(tetrazol-5-yl-methoxy)-5-{2-(2RS-hydroxy-3-(4-methoxyphenoxy)propylthio)ethyl}naphthalene



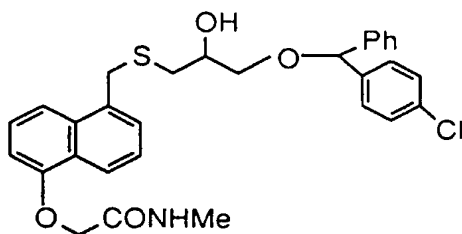
Under an atmosphere of argon gas, the compound prepared in Example 10(3) (178 mg), sodium azide (30 mg) and ammonium chloride (22 mg) were suspended in DMF (5 ml). The suspension was stirred for 20 hours at 80°C. The reaction mixture was cooled to room temperature. To the mixture, water was added. The mixture was stirred, extracted with ethyl acetate three times. The organic layer was washed with water two times and a saturated aqueous solution of sodium chloride one time, dried over with anhydrous magnesium sulfate and concentrated. The white powder obtained was washed with diethylether to give the present invention compound (120 mg) having the following physical data.

TLC : Rf 0.53 (MeOH : CHCl₃ : AcOH=1 : 18 : 1);MS (FAB) : m/z 467 (M+H)⁺;

NMR (DMSO-d₆) : δ 8.19 (1H, t, J=5.2Hz), 7.69 (1H, d, J=8.4Hz), 7.49 (1H, d, J=8Hz), 7.45 (2H, m), 7.16 (1H, d, J=7.4Hz), 6.84 (4H, s), 5.67 (2H, s), 5.22 (1H, brs), 3.92 (1H, m), 3.90 (2H, m), 3.69 (3H, s), 3.30 (2H, t, J=8.2Hz), 2.89 (2H, t, J=8.2Hz), 2.81 (1H, dd, J=13, 5.2Hz), 2.68 (1H, dd, J=13, 6.2Hz).

Example 15

N-methyl-5-[2RS-hydroxy-3-(1-phenyl-1-(4-chlorophenyl)methoxy)propylthio]methyl-1-naphthyloxy}acetic acid amide



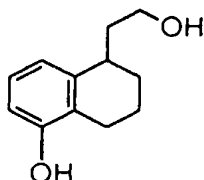
To the solution of the compound prepared in Example 8(7) (325 mg) in THF (3.0 ml), aqueous 40% methylamine solution (0.6 ml) was added. The solution was stirred for 2.5 hours at 45°C. The reaction mixture was diluted with ethyl acetate, washed with 1N aqueous solution of hydrochloric acid, water and a saturated aqueous solution of sodium chloride, successingly, dried over with anhydrous magnesium sulfate and concentrated under the reduced pressure. The residue was purified on silica gel column chromatography (CHCl₃ : MeOH=30 : 1) to give the present invention compound (312 mg) having the following physical data.

TLC : Rf 0.64 (MeOH : CHCl₃=1 : 10);MS (FAB) : m/z 536 (M+1)⁺, 334, 261, 228, 201;

EP 0 845 451 A1

NMR (CDCl₃) : δ 8.18 (1H, m), 7.78 (1H, d, J=8.6Hz), 7.34 (12H, m), 6.83 (1H, d, J=7.7Hz), 6.58 (1H, brs), 5.32 (1H, s), 4.70 (2H, s), 4.18 (2H, s), 3.93 (1H, m), 3.46 (2H, d, J=5.1Hz), 2.93 (3H, d, J=5.0Hz), 2.71 (1H, dd, J=5.2, 13.8Hz), 2.63 (1H, dd, J=1.8, 7.2Hz), 2.56 (1H, d, J=4.0Hz).

Reference Example 40

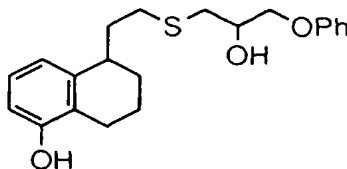


To the solution of 1-(2-hydroxy-ethyliden)-5-hydroxy-1,2,3,4-tetrahydronaphthalene (2.1 g) in ethanol (15 ml), 10% Pd-C (200 mg) was added under an atmosphere of argon gas. The mixture was stirred vigorously under an atmosphere of H₂ gas for 1 hour at room temperature. The reaction mixture was filtrated by Celite (Registered trade mark). The filtrate was concentrated under the reduced pressure to give the title compound (1.74 g) having the following physical data.

TLC : Rf 0.40 (hexane : AcOEt=2 : 1).

Example 16

1-[2-[5-hydroxy-1-(1,2,3,4-tetrahydronaphthyl)]ethylthio]-3-phenoxy-2RS-propanol

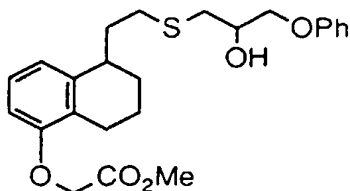


By using the compound prepared from the compound prepared in Reference Example 40 by the same procedure as Reference Example 12 → Reference Example 21, and the compound prepared in Reference Example 5, the present invention compound having the following physical data was obtained by the same procedure as Reference Example 24 → Example 1.

TLC : Rf 0.36 (hexane : AcOEt=2 : 1);

NMR (CDCl₃) : δ 7.30 (2H, m), 6.96 (4H, m), 6.75 (1H, d, J=7.9Hz), 6.61 (1H, d, J=7.9Hz), 4.75 (1H, m), 4.10 (3H, m), 2.50-3.00 (7H, m), 1.60-2.05 (6H, m).

5



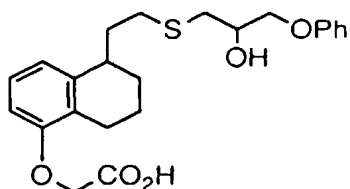
15

20

NMR (CDCl₃) : δ 7.29 (2H, m), 7.00 (4H, m), 6.82 (1H, d, J=4.6Hz), 6.52 (1H, d, J=4.8), 4.63 (2H, s), 4.10 (3H, m), 3.80 (3H, s), 2.55-2.97 (8H, m), 1.60-2.10 (6H, m).

25 Example 18

30



40

45

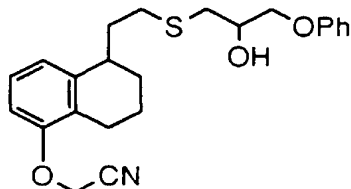
NMR (CDCl₃) : δ 7.30 (2H, m), 6.82-7.13 (5H, m), 6.55 (1H, d, J=8.0Hz), 4.66 (2H, s), 4.09 (3H, m), 2.50-2.98 (7H, m), 1.60-2.10 (6H, m).

50

55

Example 19

1-cyanomethoxy-5-[2-(2RS-hydroxy-3-phenoxypropylthio)ethyl]-5,6,7,8-tetrahydronaphthalene



By using the compound prepared in Example 16, the present invention compound having the following physical data was obtained by the same procedure as Example 10.

TLC : Rf 0.33 (acetone : benzene=1 : 19);

MS (EI) : m/z 397 (M)+, 304, 286, 245, 213, 184, 173, 157, 145;

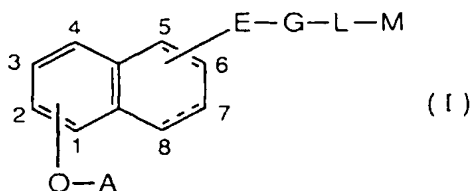
NMR (CDCl₃) : δ 7.30 (2H, m), 7.13 (1H, dd, J=8.0, 8.0Hz), 6.95 (4H, m), 6.71 (1H, d, J=8.0Hz), 4.76 (2H, s), 4.10 (3H, m), 2.50-3.00 (8H, m), 1.54-2.08 (6H, m).Formulation example 1

The following compounds were admixed in conventional method and punched out to obtain 100 tablets each containing 5 mg of active ingredient.

• 2-[5-[2-(2RS-hydroxy-3-phenoxypropylthio)ethyl]-1-naphthyloxy]acetic acid	500 mg
• Carboxymethylcellulose calcium	200 mg
• Magnesium stearate	100 mg
• Micro crystalline cellulose	9.2 g

Claims

1. A naphthyloxyacetic acid derivative of the general formula (I)



wherein

A is

(i) hydrogen,

EP 0 845 451 A1

- (ii) -(C1-4 alkylene)-COOR¹ in which R¹ is hydrogen or C1-4 alkyl,
 (iii) -(C1-4 alkylene)-CONR²R³ in which R² and R³ each, independently, is hydrogen or C1-4 alkyl,
 (iv) -(C1-4 alkylene)-OH,
 (v) -(C1-4 alkylene)-tetrazolyl or
 (vi) -(C1-4 alkylene)-CN;

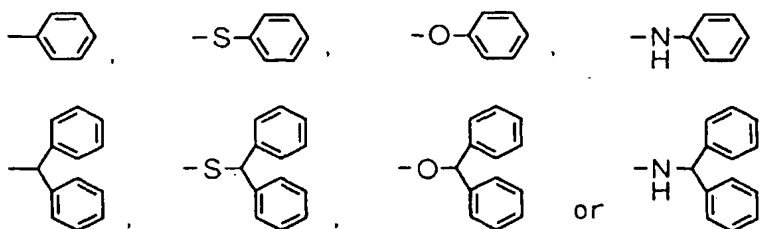
E is

- (i) single bond or
 (ii) C1-6 alkylene;

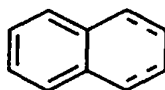
G is -S-, -SO-, -SO₂-, -O- or -NR⁴- in which, R⁴ is hydrogen or C1-4 alkyl;
 L is

- (i) C1-6 alkylene,
 (ii) -(CH₂)_m-CH=CH-(CH₂)_n- in which m is 0 or an integer of 1-3, n is 0 or an integer of 1-3 or
 (iii) -(CH₂)_x-CH(OH)-(CH₂)_y- in which x is an integer of 1-3, y is 0 or an integer of 1-3;

M is

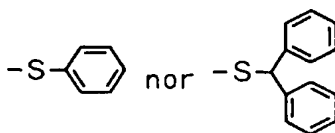


in which each phenyl group may be substituted by 1-3 of C1-4 alkyl, C1-4 alkoxy, halogen, nitro or trifluoromethyl;
 in the formula



--- is single bond or double bond;
 with the proviso that,

(1) when G is -SO- or -SO₂-, M is neither

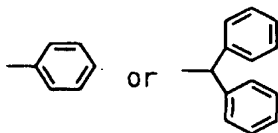


in which each phenyl group may be substituted by 1-3 of C1-4 alkyl, C1-4 alkoxy, halogen, nitro or trifluorome-

thyl,

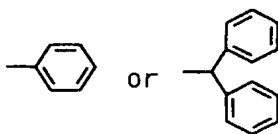
(2) when m in L is 0, G is -SO- or -SO₂-,

(3) when n in L is 0, M is



in which each phenyl group may be substituted by 1-3 of C1-4 alkyl, C1-4 alkoxy, halogen, nitro or trifluoromethyl,

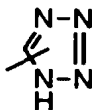
(4) when y in L is 0, M is



in which each phenyl group may be substituted by 1-3 of C1-4 alkyl, C1-4 alkoxy, halogen, nitro or trifluoromethyl,

(5) when A is hydrogen, L is -(CH₂)_m-CH=CH-(CH₂)_n- or -(CH₂)_x-CH(OH)-(CH₂)_y- in which m, n, x and y are as defined in claim 1, and

(6) tetrazolyl in A is



or non-toxic salt thereof, non-toxic acid addition salt thereof or hydrate thereof.

2. A compound according to claim 1, wherein A is -(C1-4 alkylene)-COOR¹.

3. A compound according to claim 1, wherein A is -(C1-4 alkylene)-CONR²R³, -(C1-4 alkylene)-OH, -(C1-4 alkylene)-tetrazolyl or -(C1-4 alkylene)-CN.

4. A compound according to claim 1, wherein A is hydrogen.

5. A compound according to claim 1-5, wherein L is -(CH₂)_m-CH=CH-(CH₂)_n or -(CH₂)_x-CH(OH)-(CH₂)_y.

6. A compound according to claim 5, wherein G is -S-, -SO- or -SO₂-.

7. A compound according to claim 5, wherein G is -O-.

8. A compound according to claim 5, wherein G is -NR⁴-.

9. A compound according to claim 6, which is

(1) 1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-phenoxy-2RS-propanol,

- (2) 1-[2-(5-hydroxy-1-naphthyl)ethylsulfanyl]-3-phenoxy-2RS-propanol,
- (3) 1-[2-(5-hydroxy-1-naphthyl)ethylsulfonfyl]-3-phenoxy-2RS-propanol,
- (4) 1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-phenoxy-2R-propanol,
- (5) 1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-phenoxy-2S-propanol,
- 5 (6) 1-(5-hydroxy-1-naphthyl)methylthio-3-phenoxy-2RS-propanol,
- (7) 1-(5-hydroxy-1-naphthyl)methylsulfanyl-3-phenoxy-2RS-propanol,
- (8) 1-(5-hydroxy-1-naphthyl)methylsulfonfyl-3-phenoxy-2RS-propanol,
- (9) 2-[3-(5-hydroxy-1-naphthyl)propylthio]-1-phenyl-1RS-ethanol,
- (10) 2-[3-(5-hydroxy-1-naphthyl)propylsulfanyl]-1-phenyl-1RS-ethanol,
- 10 (11) 2-[3-(5-hydroxy-1-naphthyl)propylsulfonfyl]-1-phenyl-1RS-ethanol,
- (12) 1-(5-hydroxy-1-naphthyl)thio-3-phenoxy-2RS-propanol,
- (13) 1-(5-hydroxy-1-naphthyl)sulfanyl-3-phenoxy-2RS-propanol,
- (14) 1-(5-hydroxy-1-naphthyl)sulfonfyl-3-phenoxy-2RS-propanol,
- (15) 1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-(4-chlorophenoxy)-2RS-propanol,
- 15 (16) 1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-(4-methylphenoxy)-2RS-propanol,
- (17) 1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-(4-methoxyphenoxy)-2RS-propanol,
- (18) 1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-diphenylmethoxy-2RS-propanol,
- (19) 1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-[1-phenyl-1-(4-chlorophenyl)methoxy]-2RS-propanol,
- (20) 1-[2-(5-hydroxy-1-naphthyl)ethylthio]-3-phenylthio-2RS-propanol,
- 20 (21) 1-(5-hydroxy-1-naphthyl)methylthio-3-diphenylmethoxy-2RS-propanol,
- (22) 1-(5-hydroxy-1-naphthyl)methylthio-3-[1-phenyl-1-(4-chlorophenyl)methoxy]-2RS-propanol,
- (23) 2-[5-[2-(2RS-hydroxy-3-phenoxypropylthio)ethyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (24) 2-[5-[2-(2RS-hydroxy-3-phenoxypropylsulfanyl)ethyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (25) 2-[5-[2-(2RS-hydroxy-3-phenoxypropylsulfonfyl)ethyl]-1-naphthyl]oxy}acetic acid methyl ester,
- 25 (26) 2-[5-[2-(2R-hydroxy-3-phenoxypropylthio)ethyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (27) 2-[5-[2-(2S-hydroxy-3-phenoxypropylthio)ethyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (28) 2-[5-[2-(2RS-hydroxy-3-phenoxypropylthio)methyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (29) 2-[5-[2-(2RS-hydroxy-3-phenoxypropylsulfanyl)methyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (30) 2-[5-[2-(2RS-hydroxy-3-phenoxypropylsulfonfyl)methyl]-1-naphthyl]oxy}acetic acid methyl ester,
- 30 (31) 2-[5-[3-(2RS-hydroxy-2-phenylethylthio)propyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (32) 2-[5-[3-(2RS-hydroxy-2-phenylethylsulfanyl)propyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (33) 2-[5-[3-(2RS-hydroxy-2-phenylethylsulfonfyl)propyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (34) 2-[5-(2RS-hydroxy-3-phenoxypropylthio)-1-naphthyl]oxy}acetic acid methyl ester,
- (35) 2-[5-(2RS-hydroxy-3-phenoxypropylsulfanyl)-1-naphthyl]oxy}acetic acid methyl ester,
- 35 (36) 2-[5-(2RS-hydroxy-3-phenoxypropylsulfonfyl)-1-naphthyl]oxy}acetic acid methyl ester,
- (37) 2-[5-(3-styrylsulfonfylpropyl)-1-naphthyl]oxy}acetic acid methyl ester,
- (38) 2-[5-(3-styrylsulfanylpropyl)-1-naphthyl]oxy}acetic acid methyl ester,
- (39) 2-[5-[2-(2RS-hydroxy-3-(4-chlorophenoxy)propylthio)ethyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (40) 2-[5-[2-(2RS-hydroxy-3-(4-methylphenoxy)propylthio)ethyl]-1-naphthyl]oxy}acetic acid methyl ester,
- 40 (41) 2-[5-[2-(2RS-hydroxy-3-(4-methoxyphenoxy)propylthio)ethyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (42) 2-[5-[2-(2RS-hydroxy-3-diphenylmethoxypropylthio)ethyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (43) 2-[5-[2-(2RS-hydroxy-3-(1-phenyl-1-(4-chlorophenyl)methoxy)propylthio)ethyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (44) 2-[5-[2-(2RS-hydroxy-3-phenylthiopropylthio)ethyl]-1-naphthyl]oxy}acetic acid methyl ester,
- 45 (45) 2-[5-(2RS-hydroxy-3-diphenylmethoxypropylthio)methyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (46) 2-[5-[2RS-hydroxy-3-(1-phenyl-1-(4-chlorophenyl)methoxy)propylthio)methyl]-1-naphthyl]oxy}acetic acid methyl ester,
- (47) 2-[5-[2-(2RS-hydroxy-3-phenoxypropylthio)ethyl]-1-naphthyl]oxy}acetic acid,
- (48) 2-[5-[2-(2RS-hydroxy-3-phenoxypropylsulfanyl)ethyl]-1-naphthyl]oxy}acetic acid,
- 50 (49) 2-[5-[2-(2RS-hydroxy-3-phenoxypropylsulfonfyl)ethyl]-1-naphthyl]oxy}acetic acid,
- (50) 2-[5-[2-(2R-hydroxy-3-phenoxypropylthio)ethyl]-1-naphthyl]oxy}acetic acid,
- (51) 2-[5-[2-(2S-hydroxy-3-phenoxypropylthio)ethyl]-1-naphthyl]oxy}acetic acid,
- (52) 2-[5-(2RS-hydroxy-3-phenoxypropylthio)methyl]-1-naphthyl]oxy}acetic acid,
- (53) 2-[5-(2RS-hydroxy-3-phenoxypropylsulfanyl)methyl]-1-naphthyl]oxy}acetic acid,
- 55 (54) 2-[5-(2RS-hydroxy-3-phenoxypropylsulfonfyl)methyl]-1-naphthyl]oxy}acetic acid,
- (55) 2-[5-[3-(2RS-hydroxy-2-phenylethylthio)propyl]-1-naphthyl]oxy}acetic acid,
- (56) 2-[5-(2RS-hydroxy-3-phenoxypropylthio)-1-naphthyl]oxy}acetic acid,
- (57) 2-[5-(2RS-hydroxy-3-phenoxypropylsulfanyl)-1-naphthyl]oxy}acetic acid,

- (58) 2-[5-(2RS-hydroxy-3-phenoxypropylsulfonyl)-1-naphthyl]oxy}acetic acid,
 (59) 2-[5-(3-styrylsulfinylpropyl)-1-naphthyl]oxy}acetic acid,
 (60) 2-[5-(3-styrylsulfonylpropyl)-1-naphthyl]oxy}acetic acid,
 (61) 2-[5-[2-(2RS-hydroxy-3-(4-chlorophenoxy)propylthio)ethyl]-1-naphthyl]oxy}acetic acid,
 (62) 2-[5-[2-(2RS-hydroxy-3-(4-methylphenoxy)propylthio)ethyl]-1-naphthyl]oxy}acetic acid,
 (63) 2-[5-[2-(2RS-hydroxy-3-(4-methoxyphenoxy)propylthio)ethyl]-1-naphthyl]oxy}acetic acid,
 (64) 2-[5-[2-(2RS-hydroxy-3-diphenylmethoxypropylthio)ethyl]-1-naphthyl]oxy}acetic acid,
 (65) 2-[5-[2-(2RS-hydroxy-3-phenylthiopropylthio)ethyl]-1-naphthyl]oxy}acetic acid,
 (66) 2-[5-(2RS-hydroxy-3-diphenylmethoxypropylthio)methyl-1-naphthyl]oxy}acetic acid,
 (67) 1-cyanomethoxy-5-[2-(2RS-hydroxy-3-phenoxypropylthio)ethyl]naphthalene,
 (68) 1-cyanomethoxy-5-[2-(2RS-hydroxy-3-(4-chlorophenoxy)propylthio)ethyl]naphthalene,
 (69) 1-cyanomethoxy-5-[2-(2RS-hydroxy-3-(4-methylphenoxy)propylthio)ethyl]naphthalene,
 (70) 1-cyanomethoxy-5-[2-(2RS-hydroxy-3-(4-methoxyphenoxy)propylthio)ethyl]naphthalene,
 (71) 1-cyanomethoxy-5-[2-(2RS-hydroxy-3-diphenylmethoxypropylthio)ethyl]naphthalene,
 (72) 1-cyanomethoxy-5-[2-(2RS-hydroxy-3-phenylthiopropylthio)ethyl]naphthalene,
 (73) 1-cyanomethoxy-5-[(2RS-hydroxy-3-diphenylmethoxy)propylthiomethyl]naphthalene,
 (74) 2-[5-[2-(2RS-hydroxy-3-(1-phenyl-1-(4-chlorophenyl)methoxy)propylthio)ethyl]-1-naphthyl]oxy}ethanol,
 (75) 2-[5-[2-(2RS-hydroxy-3-phenylaminopropylthio)ethyl]-1-naphthyl]oxy}ethanol,
 (76) 1-(tetrazol-5-ylmethoxy)-5-[2-(2RS-hydroxy-3-(4-methoxyphenoxy)propylthio)ethyl]naphthalene,
 (77) N-methyl-5-[2-(2RS-hydroxy-3-(1-phenyl-1-(4-chlorophenyl)methoxy)propylthio)methyl-1-naphthyl]oxy}acetic acid amide,
 (78) 1-[2-[5-hydroxy-1-(1,2,3,4-tetrahydronaphthyl)]ethylthio]-3-phenoxy-2RS-propanol,
 (79) 2-[5-[2-(2RS-hydroxy-3-phenoxypropylthio)ethyl]-1-(5,6,7,8-tetrahydronaphthyl)]oxy}acetic acid methyl ester,
 (80) 2-[5-[2-(2RS-hydroxy-3-phenoxypropylthio)ethyl]-1-(5,6,7,8-tetrahydronaphthyl)]oxy}acetic acid or
 (81) 1-cyanomethoxy-5-[2-(2RS-hydroxy-3-phenoxypropylthio)ethyl]-5,6,7,8-tetrahydronaphthalene.

10. A compound according to claim 7, which is

- (1) 1-[2-(5-hydroxy-1-naphthyl)ethoxy]-3-phenoxy-2RS-propanol,
 (2) 2-[5-[2-(2RS-hydroxy-3-phenoxypropoxy)ethyl]-1-naphthyl]oxy}acetic acid methyl ester or
 (3) 2-[5-[2-(2RS-hydroxy-3-phenoxypropoxy)ethyl]-1-naphthyl]oxy}acetic acid.

11. A compound according to claim 8, which is

- (1) 1-[2-(5-hydroxy-1-naphthyl)ethylamino]-3-phenoxy-2RS-propanol or
 (2) 2-[5-[2-(2RS-hydroxy-3-phenoxypropylamino)ethyl]-1-naphthyl]oxy}acetic acid.

12. A pharmaceutical composition which comprises a naphthyl oxyacetic acid derivative of the formula (I) depicted in claim 1, non-toxic salt thereof, non-toxic acid addition salt thereof or hydrate thereof.

13. A prostaglandin E₂ antagonist or agonist which comprises a naphthyl oxyacetic acid derivative of the formula (I) depicted in claim 1, non-toxic salt thereof, non-toxic acid addition salt thereof or hydrate thereof.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP96/01833

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl⁶ C07C43/178, 43/196, 43/23, 217/30, 217/48, 317/18,
317/20, 317/22, 323/16, 323/17, 323/18, C07D257/04, A61K31/075,
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int. Cl⁶ C07C43/178, 43/196, 43/23, 217/30, 217/48, 317/18,
317/20, 317/22, 323/16, 323/17, 323/18, C07D257/04, A61K31/075,

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CAS ONLINE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	JP, 57-176922, A (Fisons Ltd.), October 30, 1982 (30. 10. 82), Claim; example 9 & EP, 61800, A & US, 4424231, A	1, 2, 7, 12 3-6, 8-11, 13
X A	JP, 7-70013, A (Sanofi), March 14, 1995 (14. 03. 95), Claim & EP, 626367, A1 & US, 5488151, A	1, 2, 5, 8, 12 3, 4, 6, 7, 9-11, 13
X A	JP, 6-506676, A (Fujisawa Pharmaceutical Co., Ltd.), July 28, 1994 (28. 07. 94), Claim & WO, 92/18461, A1 & EP, 579833, A1	1, 2, 5, 8, 12 3, 4, 6, 7, 9-11, 13
X A	JP, 4-210663, A (Sanofi), July 31, 1992 (31. 07. 92), Claim & EP, 436435, A & US, 5130339, A	1, 2, 5, 8, 12 3, 4, 6, 7, 9-11, 13
X A	JP, 3-31212, A (Sanofi), February 12, 1991 (12. 02. 91), Claim & EP, 403360, A & US, 5236951, A	1, 2, 5, 8, 12 3, 4, 6, 7, 9-11, 13
X	JP, 3-14548, A (Sanofi),	1, 2, 5, 8, 12

☒ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

September 5, 1996 (05. 09. 96)

Date of mailing of the international search report

September 17, 1996 (17. 09. 96)

Name and mailing address of the ISA/

Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP96/01833

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	January 23, 1991 (23. 01. 91), Claim & EP, 383686, A & US, 5312961, A	3, 4, 6, 7, 9-11, 13
X A	JP, 64-66152, A (Sanofi), March 13, 1989 (13. 03. 89), Claim & EP, 303546, A & US, 4927955, A	1, 2, 5, 8, 12 3, 4, 6, 7, 9-11, 13
X A	JP, 62-63549, A (Sanofi), March 20, 1987 (20. 03. 87), Claim & EP, 211721, A & US, 4707497, A	1, 2, 5, 8, 12 3, 4, 6, 7, 9-11, 13

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

EP 0 845 451 A1

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP96/01833

A. (Continuation) CLASSIFICATION OF SUBJECT MATTER

31/085, 31/095, 31/10, 31/135, 31/40

B. (Continuation) FIELDS SEARCHED

31/085, 31/095, 31/10, 31/135, 31/40